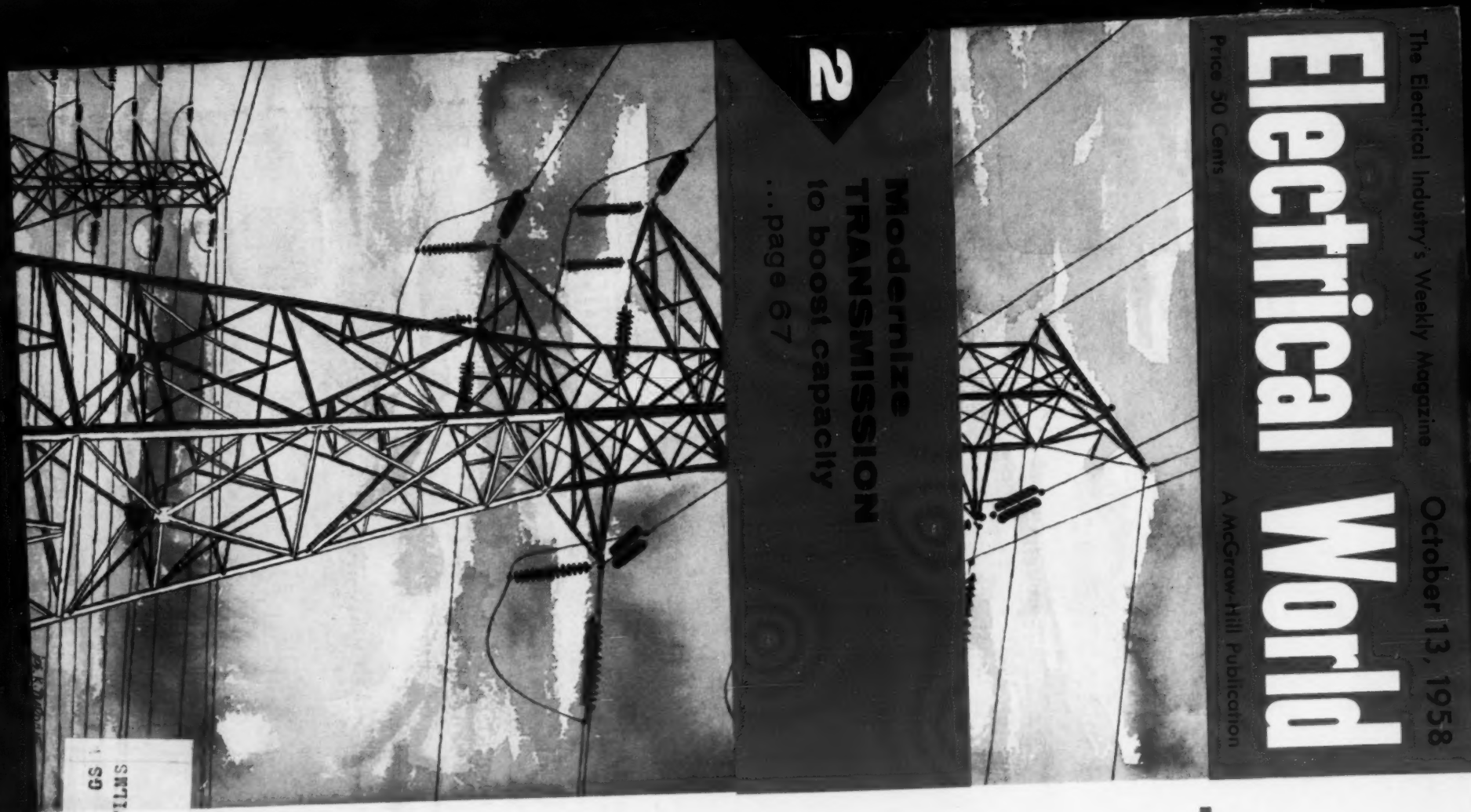

Electrical World

The Electrical Industry's Weekly Magazine

October 13, 1958

Price 30 Cents

A McGraw-Hill Publication

2

Modernize TRANSMISSION to boost capacity

....page 67

STEVENS RICE GS
UNIVERSITY MICROFILMS
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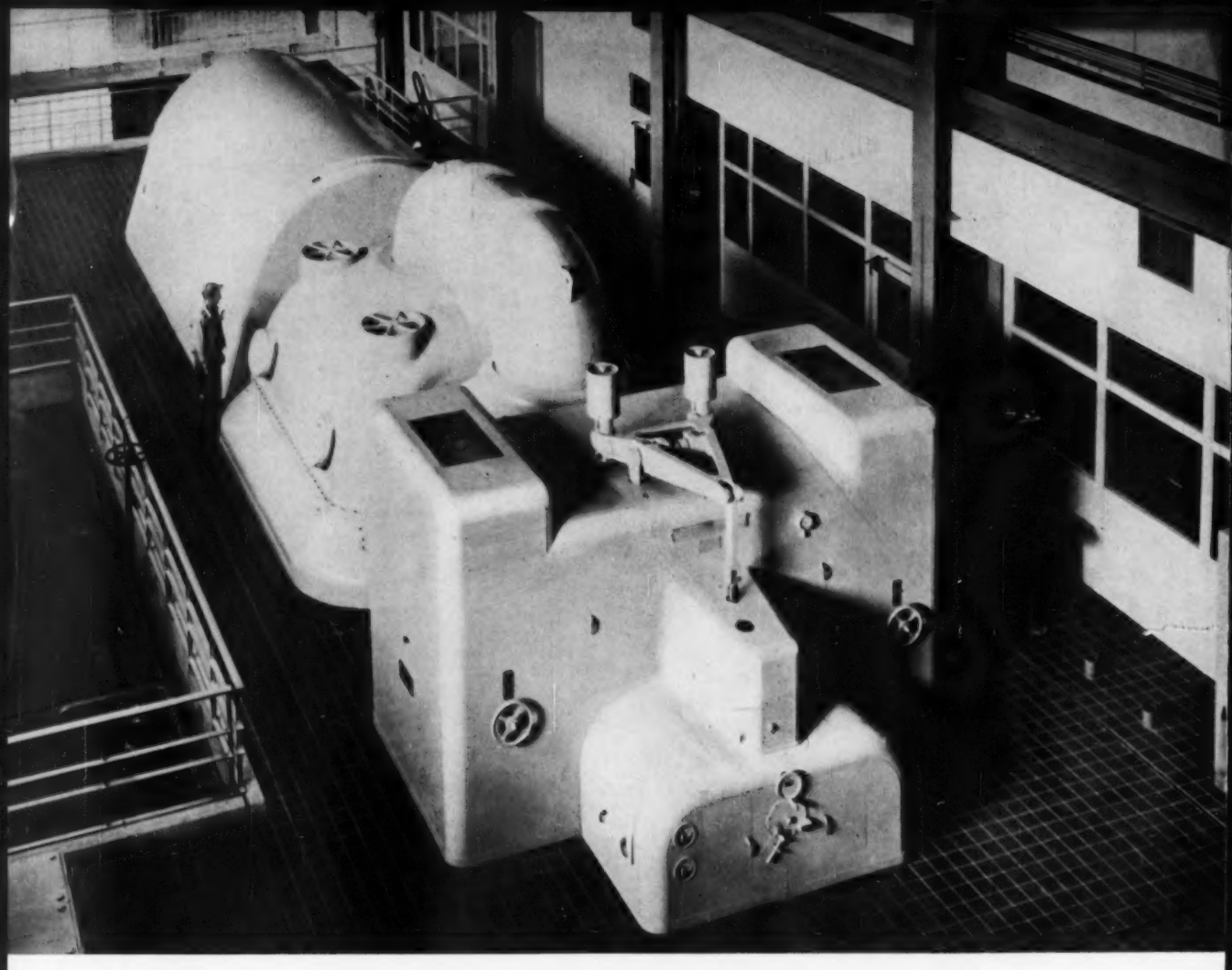
PLAN '59

Modernize now for growth and profits

A SPECIAL REPORT FROM McGRAW-HILL TO AMERICA'S BUSINESS EXECUTIVES

Electrical World presents five special reports on "Modernizing Electric Power Systems"



Cut rust and oxidation — boost efficiency with Texaco Regal Oil R&O

There's extra service built into Texaco Regal Oil R&O because it gives dependable protection against rust and oxidation as it lubricates. It's a first rate lubricant fortified with extra resistance to the formation of rust, sludge and foam.

The additives in Texaco Regal Oil R&O keep systems clean. The oil circulates freely throughout an extra-long service life. The bearings stay cool and the governor runs steadily and dependably.

There is a complete line of Texaco Regal Oils R&O to give long-term protection to any type or size of turbine. A Texaco Lubrication Engineer will be glad to help you select the right oil for your equipment. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

LUBRICATION IS A MAJOR FACTOR IN COST CONTROL

(PARTS, INVENTORY, PRODUCTION, DOWNTIME, MAINTENANCE)

Electrical World

Vol. 150, No. 15 OCTOBER 13, 1958

Published for 84 years for those engaged in the business of generating, transmitting, distributing, or applying electric power

In This Week's Issue

CURRENT EVENTS

Electric Over Gas for Housing Developments

New report indicates all-electric home holds edge for government projects. Zinder gas report questioned.....p 60

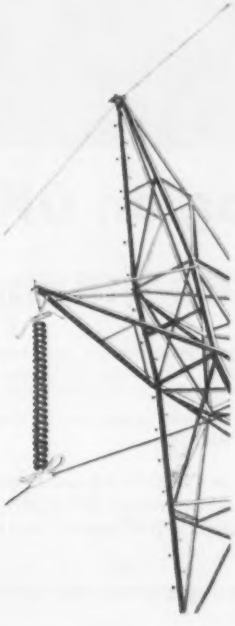
MANAGEMENT NEWSLETTER

EEI Finds 968 Utility Research Projects

Here's what electric utilities are doing in research as reported to EEI's Research Projects Committee.....p 121

Special Report

PLAN '59



Modernize Transmission to Boost Capacity

Introduction to special 16-page report points to problems of right-of-way scarcity and inadequate circuit capacity...p 67

Is Transmission Capacity In Step?

To balance transmission capacity with generating capability, industry must look to higher voltages.....p 68

Modernize Loading of Lines and Generators

With rising costs, economic loading of lines and generators can bring substantial savings.....p 72

Increase Capacity and Conserve R/W

Case studies show evolving pattern of transmission modernization .....p 74

Substation Patterns Are Changing

How utilities alter substation arrangements to meet pressure for additional capacity.....p 79

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What this tag on OKOCORD portable cords and cables means to you

This "QC" (Quality Control) tag, the final one of a series, is Standard Operating Procedure for every length of OKOCORD **before** it is shipped out to you. It's your assurance that Okonite's modern equipment, skilled craftsmanship and overall Quality Control program combine to build more **value** into OKOCORD portable cords and cables.

Here are six other steps, typical of all OKOCORD manufacturing operations, where quality is constantly checked and maintained by the Quality Control Lab and every operator and supervisor in the plant.

1. **QC Lab tests copper rod, raw materials against Research-developed standards to maintain uniform, high quality.**
2. **Strands are continuously drawn, annealed and steam cleaned with every run passed for size, strength, flexibility.**
3. **Compounds are mixed, milled, strained and refined in a continuous mechanized sequence to help eliminate error.**
4. **Microscopic examination of compound batches, in addition to physical and electrical tests, checks particle dispersion and authenticates compounding.**
5. **Latest type of continuous lead extruder eliminates damaging press stops in applying continuous mold for vulcanization—guarantee of OKOCORD's "tire-tread" toughness.**
6. **Okonite QC imposes the most rigorous tests in the industry, in process and final.**

Each reel of OKOCORD bears this quality control tag. It's your assurance that the OKOCORD you buy will be a long-term investment. The Okonite Company, Passaic, N. J.

Buy through your distributor.

Write for this newly-published 64-page catalog on OKOCORD. Full information on construction components, cable assemblies, dimensional tables, engineering data plus splicing and terminating drawings and instructions.

where there's electrical power . . . there's **OKONITE CABLE**

6379

Stop Gas Light Fad

Decorative gas lights are beginning to appear in front of new homes as a sort of fad in the Southwest and elsewhere. They may, as the ads say, lend a quaint charm to the newly developed properties. But their "soft, mellow glow" will soon turn black.

Each of these uneconomic, inefficient gadgets stand as a symbol of waste. They do, however, represent in an all too obvious manner the aggressive, effective sales drive that the gas boys are making. At the same time, they say that we electric fellows have failed to keep on our toes. They are as out of place as a Volkswagen on the streets of Detroit.

But the most disturbing fact is that these gas lights stand as a marker outside new homes indicating that this unit is not all-electric and probably won't be for some time to come. In their own "mellow" way they flount our pleas to "Be Modern—Go All-Electric."

To buck the fad, electric sales departments may want to offer a free lighting survey to any home which still sports an outmoded gas light contrivance. If that fails, it may be time to consider bounties.

Fischer Black

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ABP ELECTRICAL WORLD

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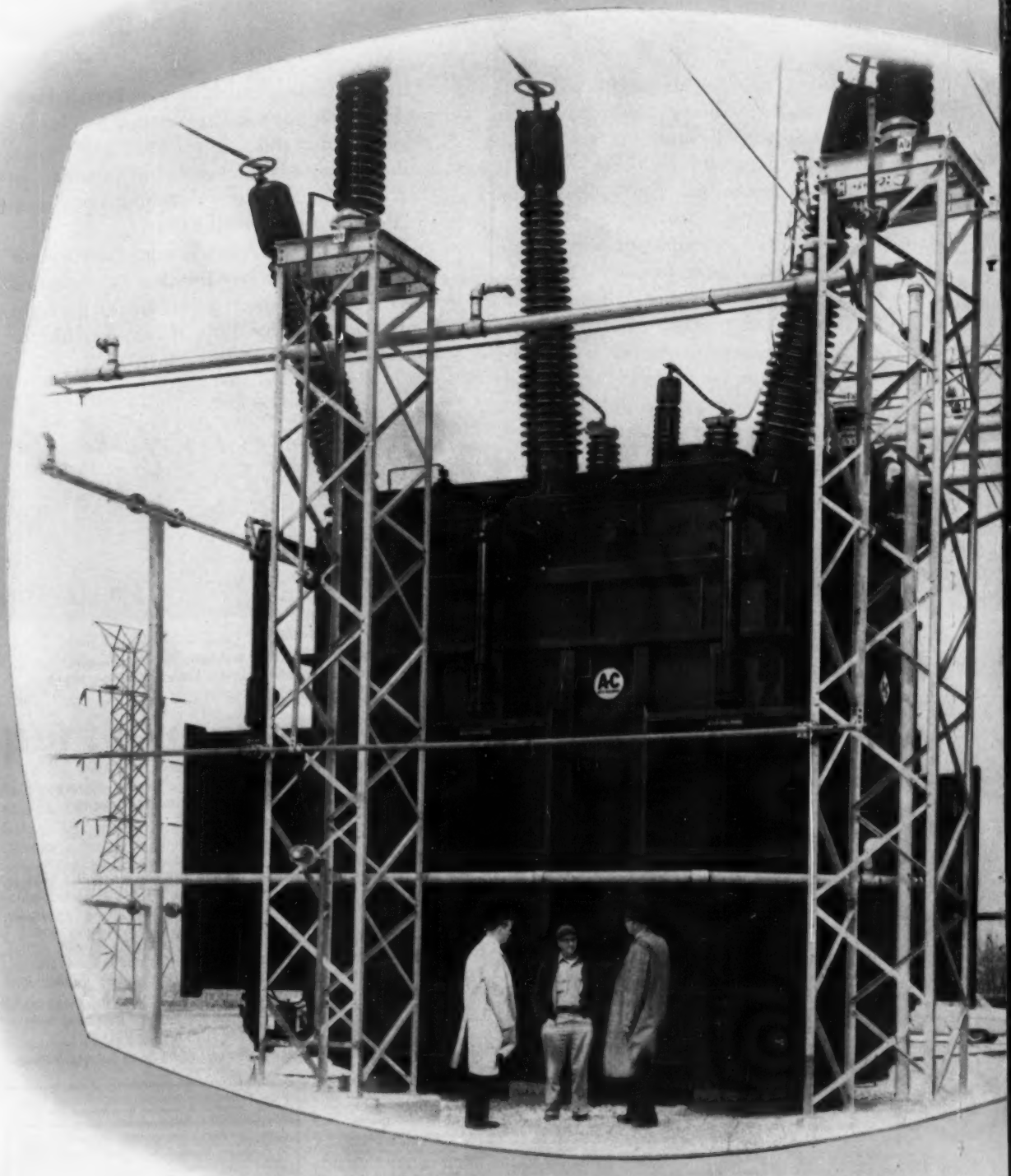
An example of Allis-Chalmers



A-5769

leadership in transformers

345,000-Volt Autotransformers for Commonwealth Edison Company

ONE of two 180,000-kva transformers recently installed at the Goodings Grove substation is shown. These units will interconnect and permit the exchange of electric power between Commonwealth Edison and the American Electric Power Company (formerly the American Gas and Electric Company).

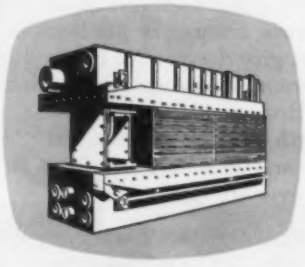
Features of these units of interest to engineers are:

- BIL is reduced two steps to 1050 kv.
- Units were subjected to both standard impulse tests and Allis-Chalmers switching surge test.

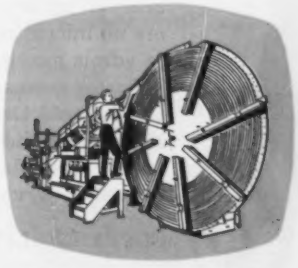
This switching surge test stresses the units differently than either impulse or low frequency tests and *scientifically* determines the ability of insulation to withstand switching surges.

- Design is corona-free to prevent insulation aging or damage due to corona.
- Weight — 480,000 pounds.
- These forced-oil-cooled units are rated 180,000 kva, 3 phase, high voltage 345 kv, low voltage 138 kv, tertiary voltage 12 kv.

For information on Allis-Chalmers transformers or test procedures, call your nearby A-C office or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.



Integral design cuts transformer size, weight; protects core and coil against mechanical shock in shipment and service.

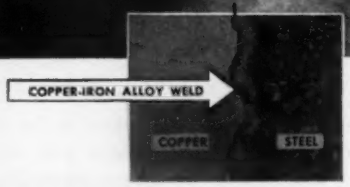


Circular disc type coils are ideal for resisting distortion stresses caused by heavy fault conditions.

ALLIS-CHALMERS

EVERY COPPERWELD GROUND ROD is

molten-welded



This microphotograph of the Molten-Weld shows how the grains of copper and steel interlock to form a permanent, continuous weld. No other process achieves this inseparable union.

WHAT'S THE ADVANTAGE?

By this unique Molten-Welding process—used only by Copperweld Steel Company—a uniformly thick sheath of pure copper is inseparably welded to an alloy steel core. Under carefully controlled conditions, the grains of both metals interlock to form a permanent, continuous weld. And from the moment of this union, Copperweld* performs as one metal. Hot rolling, cold drawing, temperature changes, pounding, or abuse cannot destroy the Molten-Weld in Copperweld Ground Rods.

WHAT DOES THE MOLTEN-WELD IN COPPERWELD MEAN TO YOU?

In service, this permanent Molten-Weld completely eliminates the possibility of harmful electro-galvanic action in the presence of moisture. There are no microscopic cracks, fissures, or pin holes in the thick copper exterior to admit moisture and give destructive rust a foothold.

So, for permanent grounding protection at lowest annual cost, insist upon Copperweld Ground Rods and get the rust resistance and conductance of copper plus the strength and easy-driving qualities of alloy steel. The time-tested dependability and economy of Copperweld products have been proved in service for over 40 years.

*Trade Mark

COPPERWELD STEEL COMPANY WIRE AND CABLE DIVISION *Glassport, Pa.*

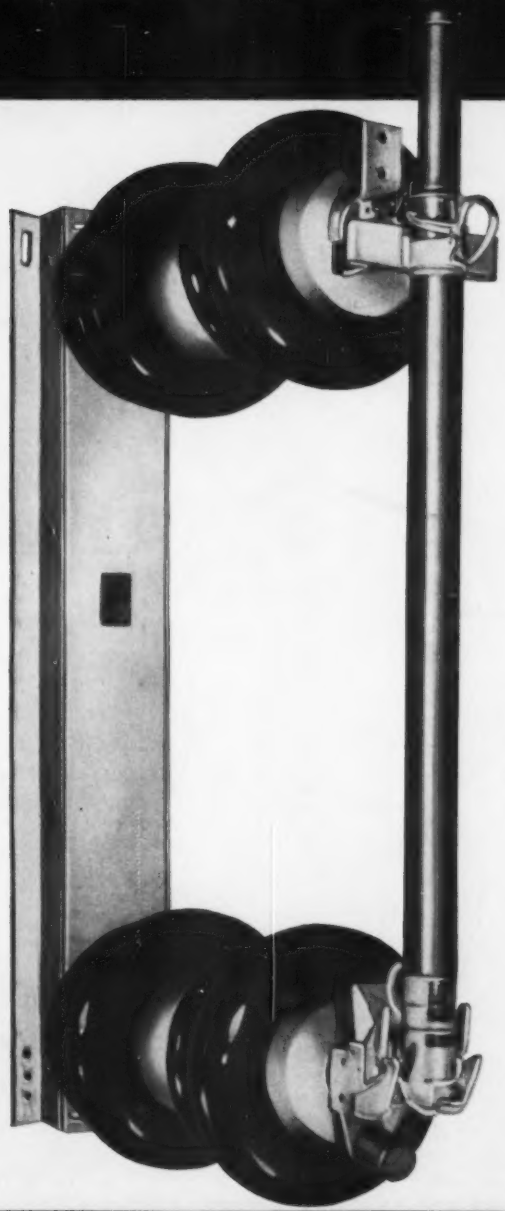
For Export: COPPERWELD STEEL INTERNATIONAL COMPANY, New York

DRIVE DEEP with Copperweld sectional ground rods

TRADE MARK

FOR low resistance THE YEAR 'ROUND

1,500,000 kva at 69 kv!



a breakthrough in power fuse short-circuit protection

A completely new principle in boric acid circuit interruption has been incorporated into the new SMD-2A Power Fuse. It gives you interrupting ratings 50% higher than any other high-voltage power fuse.

Like other members of the SMD family, it provides:

1. system protection,
2. transformer protection against secondary faults, even line-to-ground,
3. use of transformer short-time daily overload capability,
4. use of transformer short-time emergency overload capability, and
5. complete and precise coordination with other overcurrent devices.

While doing this, it also gives:

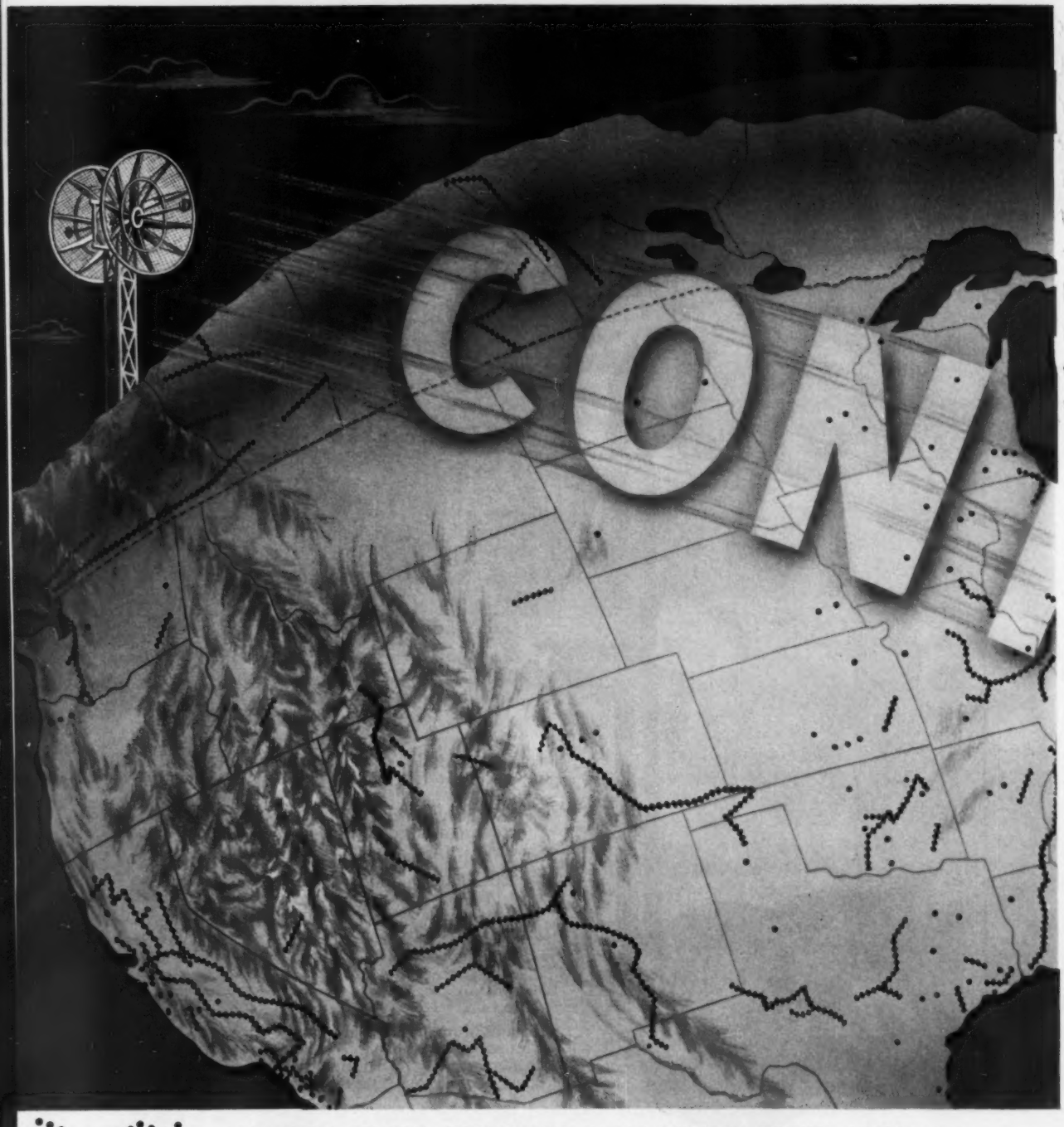
—Dependable operation regardless of type of system, type of fault, or type of application; and regardless of system, or atmospheric conditions.

—Maintenance-free performance, since there is no need to replace fuses on other phases when one fuse blows. No periodic replacement program is required to prevent "sneak outs" caused by vibration, ageing, or corona.

For additional information write to: S & C Electric Company, 4421 Ravenswood Ave., Chicago 40, Ill. In Canada: S & C Electric Canada, Ltd., 8 Vansco Road, Toronto 14, Ontario.

S&C POWER FUSES

MORE THAN A MILLION CHANNEL MILES



MAJOR USERS OF RCA MICROWAVE RADIO SYSTEMS SHOWN ABOVE

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Alberta Government Telephone, Alberta, Canada
Alberta Government Telephone, Edmonton, Alberta
Allied Air Force (NATO)
Arizona Public Service Company, Phoenix, Arizona
Arkansas State Game and Commission, Little Rock, Arkansas
Atlantic Pipe Line Company, Philadelphia, Pa.
Baltimore Gas & Electric Company, Baltimore, Maryland
British Columbia Electric Company, Vancouver, B.C.
Buffalo Pipeline Corporation, Philadelphia, Penna.
Calgary Power Company, Calgary, Alberta
Canadian National Railways
City of Elyria, Elyria, Ohio
City of Los Angeles, California (Fire Dept.)
City of Philadelphia, Philadelphia, Pa. (Police Dept.)
City of San Diego, San Diego, California
City of Warren Water Dept., Warren, Ohio
Colorado Central Power Company, Englewood, Colorado
Colorado Interstate Gas Company, Colorado Springs, Colorado
Colorado State Patrol, Denver, Colorado
Chinese Nationalist Government, Formosa
Commonwealth of Virginia, Richmond, Virginia
County of Riverside, Riverside, California
County of San Mateo, California
Commonwealth Edison Company, Chicago, Illinois
El Paso Natural Gas, El Paso, Texas
General Petroleum Company, Los Angeles, California
Georgia Gas Company, Gainesville, Georgia
Government of Burma, Burma, India
Government of Cuba, Havana, Cuba
Gulf States Utilities Company, Beaumont, Texas
Hydro-Quebec, Montreal, Canada
Illinois State Toll Highway Commission, Chicago, Illinois
Indiana and Michigan Electric Company, Ft. Wayne, Indiana
Indiana State Police, Indianapolis, Indiana
Magnolia Petroleum Company, Morgan City, Louisiana
Manitoba Hydro, Quebec, Canada
Manitoba Telephone System, Winnipeg, Manitoba, Canada
New Jersey Turnpike Commission, New Brunswick, New Jersey
New South Wales Electricity Commission, Australia
Northeast Missouri Electric Power Co-Operative, Palmyra, Missouri
Northwest Telephone Company, Vancouver, B.C.
Ohio Turnpike Commission, Columbus, Ohio
Oklahoma Natural Gas Company, Tulsa, Oklahoma
Orange County, Santa Ana, California
Pacific Gas & Electric Company, San Francisco, California
Pacific Power & Light Company, Portland, Oregon
Philadelphia Electric Company, Philadelphia, Pa.
Portland General Electric Company, Portland, Oregon
Public Service Company of Oklahoma, Tulsa, Oklahoma
Putnam County, Carmel, New York
Tele-Dynamics Inc.—(Pennsylvania Turnpike)
RCA Communications, Inc., New York City, New York
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Southern California Edison Company, Los Angeles, California
State of California, Division of Highways, Sacramento, California
State of California, Sacramento, California (Civil Defense)
State of Idaho Highway Department
State of Washington (Police), Olympia, Washington
State of Washington (Highway)
Sun Pipeline Company, Beaumont, Texas
Texas Company, Salem, Illinois
Texas Gas Transmission Corporation, Owensboro, Kentucky
Tidewater Oil Company, San Francisco, California
The Western Union Telegraph Company, New York City, New York
Union Electric Company of Missouri, St. Louis, Missouri
U. S. Air Force (Spain)
Union Oil, Los Angeles, California
United Gas Pipeline Company, Shreveport, Louisiana
Utah Power & Light Company, Salt Lake City, Utah
United Gas Corporation, Shreveport, Louisiana
Western Electric Company, New York, New York

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RCA Microwave Control is sure..fast..economical

and performance-proved by an impressive list of users!

Throughout the United States, Canada and Cuba, the terrain is studded with dependable RCA Microwave Radio Systems that provide radio control of operations by management and supervisors, and equipment control.

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You can control company operations with dependable RCA Microwave by providing centralized private communications facilities for sending and receiving voice, printed messages, and electronic data.

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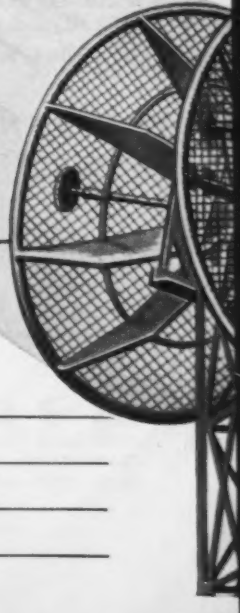
For supervisors' control, multiple voice channels assure faster, surer, less expensive service than leased or private land lines. Mobile VHF radio control becomes part of an integrated system. Facsimile, and fault reporting circuits also can be provided.

CONTROL OF EQUIPMENT

Turn on valves, operate switches, activate engines, obtain necessary data through telemetering from any remote point. In a microwave-automated system you can "beam control" across the miles . . . make a whisper a shout . . . or a trickle a roar . . . with lowest installation, operating and maintenance costs.

Product of the leader in radio and electronics, dependable RCA Microwave systems operate in the most advantageous frequency bands—the 1700-2700 mc portion of the spectrum—where techniques are well established and performance-proved. By turning over the entire responsibility for a communications project to RCA, you can relieve your own personnel of all details in connection with the system. Over a million channel miles of RCA Microwave operation represents a wealth of experience you can profitably enlist.

To find out more about RCA Microwave Radio, or to have a system engineered to your own requirements, mail coupon below.



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DEEP DEEP GROUNDING

INSURES EXTRA PROTECTION

• Heat treated, alloy steel driving stud resists mushrooming — can be used over and over. Couplings of rugged Silicon Bronze.
• Completely machined point speeds driving. All rod sections are threaded on both ends for use as top, intermediate or bottom section.
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Blackburn Sectional Rods Get Down Into The Permanently Moist Soil

Drive down to permanently moist soil that gives lower earth to rod resistance. Actual experience shows a few dollars invested in deep grounding has saved thousands of dollars in overhead burn-outs.

- BLACKBURN Sectional Rods have a uniform coating of highly conductive corrosion-resistant copper, molecularly bonded to *rigid steel core.*
- Driving studs and couplings interchangeable with all standard sectional ground rods.
- Available through Electrical Distributors.

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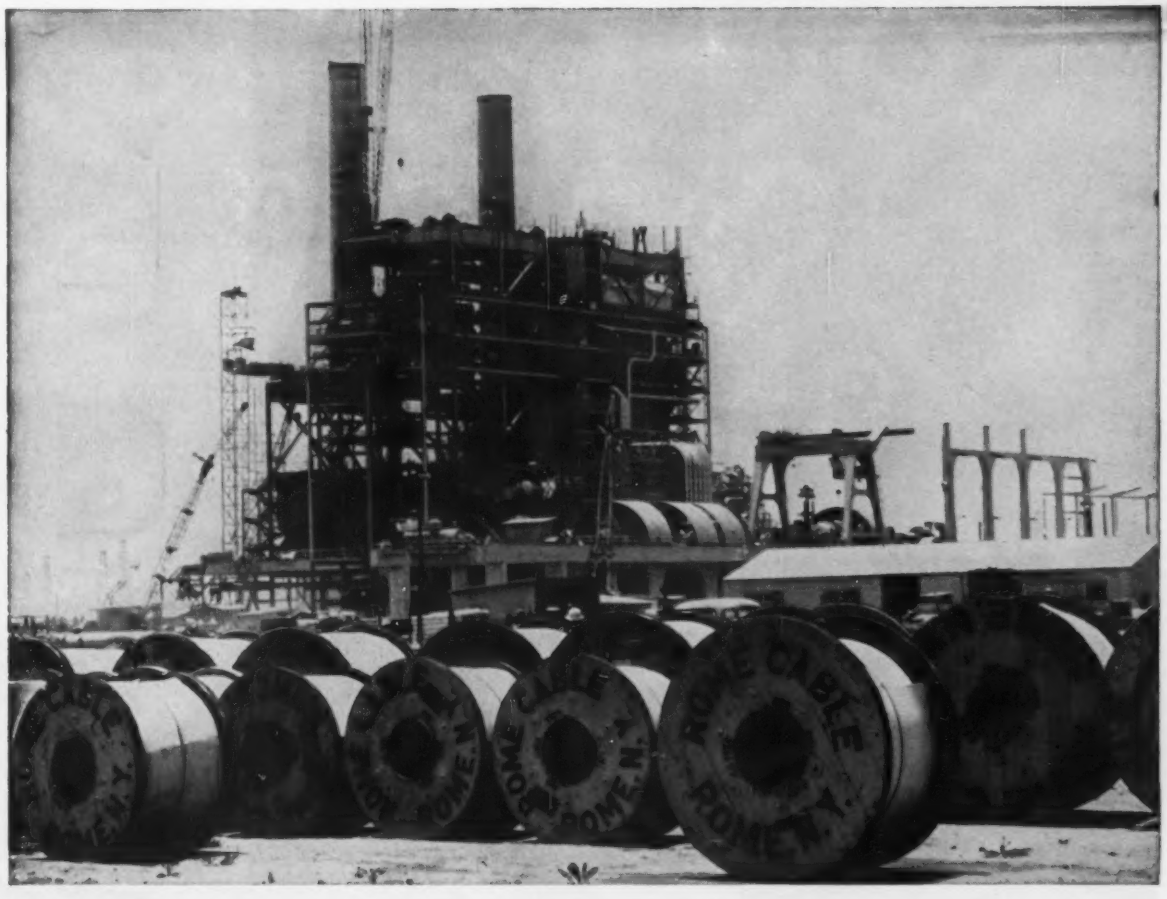
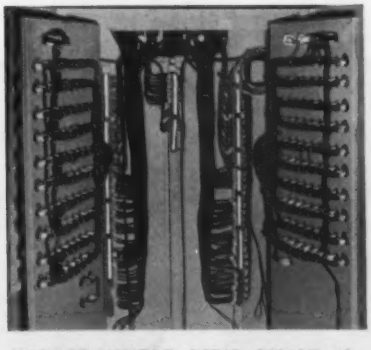
BLACKBURN *Sectional* COPPER BONDED **GROUND RODS**

Distributed on the West coast by KORTICK MFG. CO.



Southern California Edison installed . . .

¼ million feet of Rome control cable in the Alamitos steam station



EASY TO HANDLE, STRIP, SPLICE. The clean, low-friction surface of Rome's control cables enabled Alamitos workmen to pull the cable through conduits and into this cabinet quickly and easily.

For its station control circuits, this large West Coast utility selected high-quality Rozone-Roprene control cable —*253,000* feet of it. This Rome cable is a logical choice for any such permanent installation since it represents the ultimate in control cable design and performance.

Built to last. Each conductor is insulated with a premium-quality, oil-base insulating compound—Rozone—which provides excellent protection against corona and ozone cutting. Rozone is also highly resistant to water and aging. Each individual conductor is then covered with a tight-fitting color-coded Roprene (neoprene) sheath.

Over-all protection is provided by a Roprene jacket, which not only resists weather, oils, chemicals, and even flame, but also provides a high resistance to mechanical injury during and after installation. And this tough Rome Cable material is virtually immune to corrosion and electrolysis.

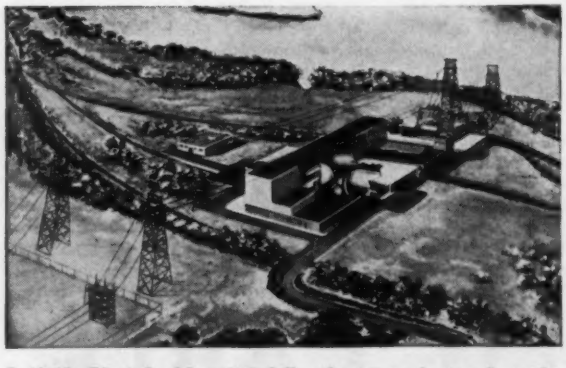
If you want the very best in station control cable for your next job, specify Rozone-Roprene. Contact your nearest Rome Cable representative for more information—or write to Department 803, Rome Cable Corporation, Rome, New York.

ROME CABLE

CORPORATION

Photos by Robert Yarnall Richie

Rome's station control cable installed



Artist's Sketch of first U. S. full-scale atomic-electric plant. This revolutionary power plant—under the operation of Duquesne Light Company of Pittsburgh—delivers electricity to home and industry in the Pittsburgh area.

Atomic-Electric Power is controlled from this large cabinet installation at the Shippingport atomic power station. Nearly ten miles of Rome's highest quality station control cable are used in this vital system.

Partner to the Atom. Rome's control cable is here being installed in the nation's first major atomic power plant at Shippingport, Pennsylvania. Rome Cable furnished over 50,000 feet of station control cable for this important installation.

in Shippingport atomic power station

This country's first full-scale atomic power plant for the generation of electricity contains almost ten miles of Rome's highest quality station control cable.

The selection of Rome's Rozone-Roprene cable—with a special over-all asbestos outer braid—for this epoch-making installation was no accident, for individual Rozone insulated-Roprene jacketed conductors represent the ultimate in control cable design and performance.

Advantages of Rozone insulation. Rozone—a high-quality oil-base compound—is an excellent insulation. Long and widespread experience has proved that its high-dielectric and impulse strength, combined with its resistance to corona and ozone cutting, makes it an ideal insulation for control and high-voltage power cables. Its electrical properties are practically unaffected by long-time immersion in water or burial in the ground.

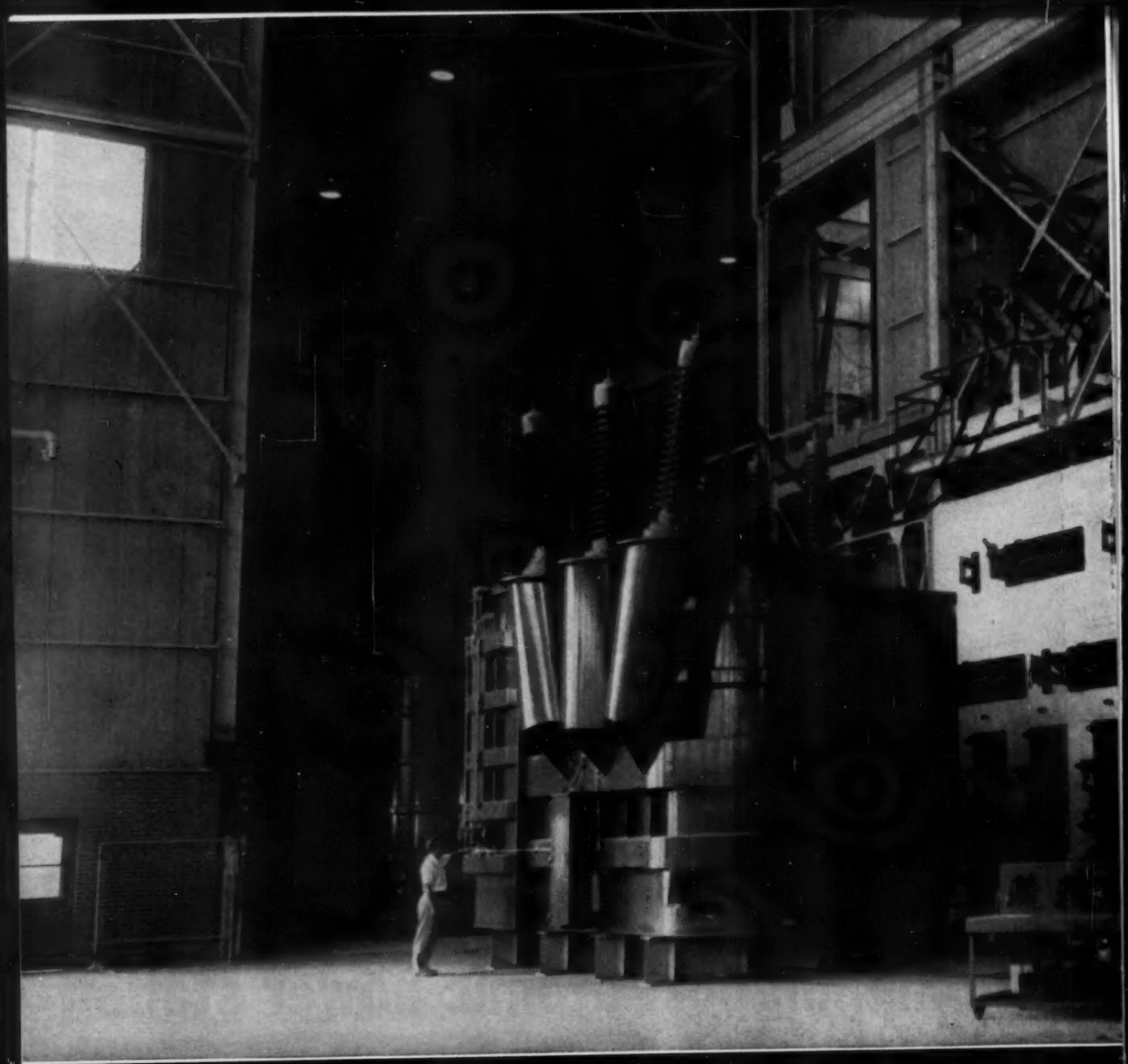
Advantages of Roprene jacket. Roprene—a neoprene synthetic rubber compound developed by Rome Cable—provides an extremely durable and permanent mechanical protective covering for the individually Rozone-insulated conductors. It assures terminations that are resistant to abrasion, weather, and attack by chemicals and oils. And it is exceptionally resistant to fire.

Additional fire protection for this particular cable included a special over-all asbestos outer braid.

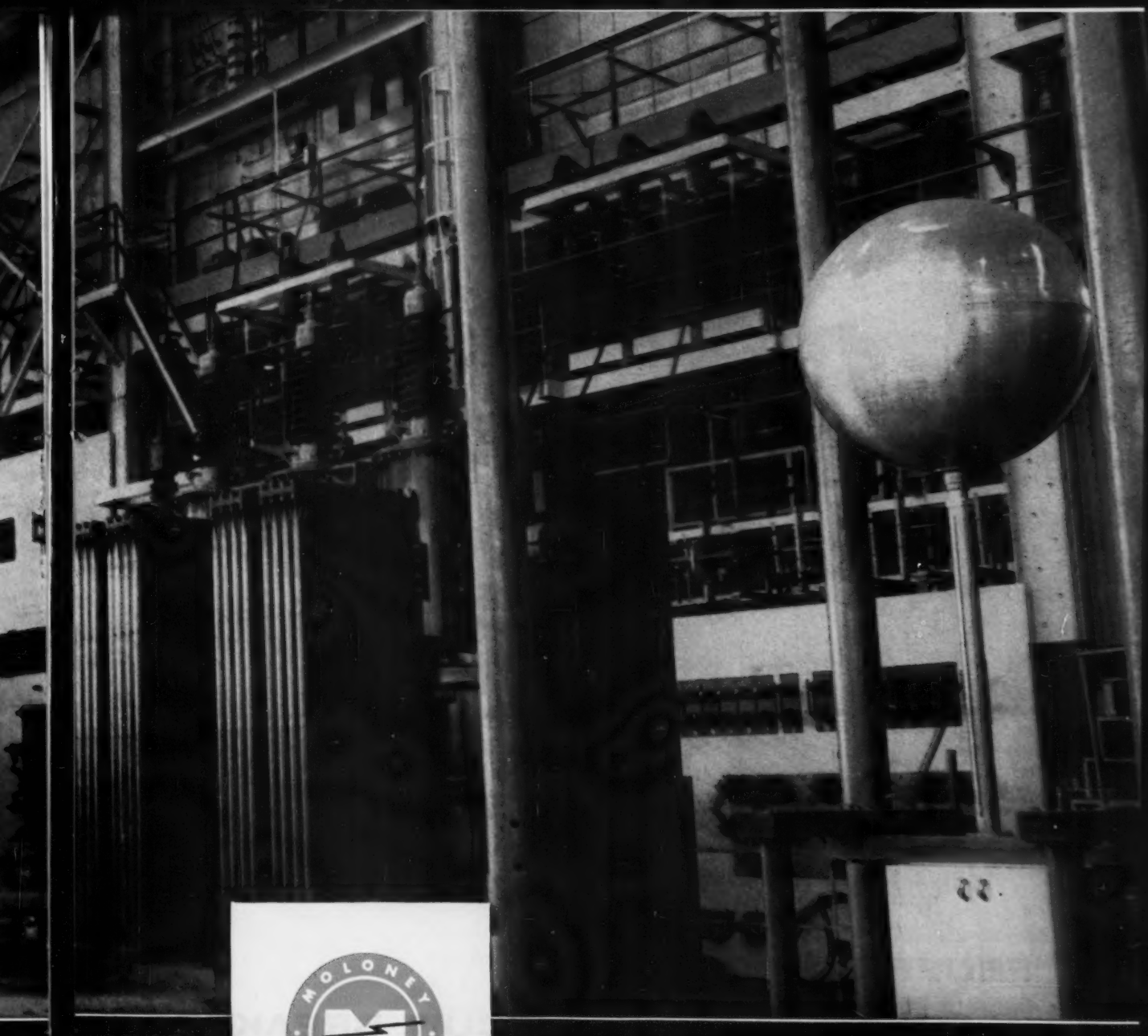
Specify premium-quality Rozone-Roprene control cable for your next job. Contact your nearest Rome Cable representative for more information—or write to Department 802R, Rome Cable Corporation, Rome, New York.

ROME CABLE

CORPORATION



PROVING GROUND



The "Proving Ground" for Moloney Power Transformers is this large, fully-equipped test area suitable for testing the largest of transformers.

Each Moloney Power Transformer undergoes thorough tests to prove that it meets industry standards and Moloney's high standards of quality and performance.

Thus, the test bay shown here can aptly be called the proving ground for future performance . . . the payoff of constant research and development programs.

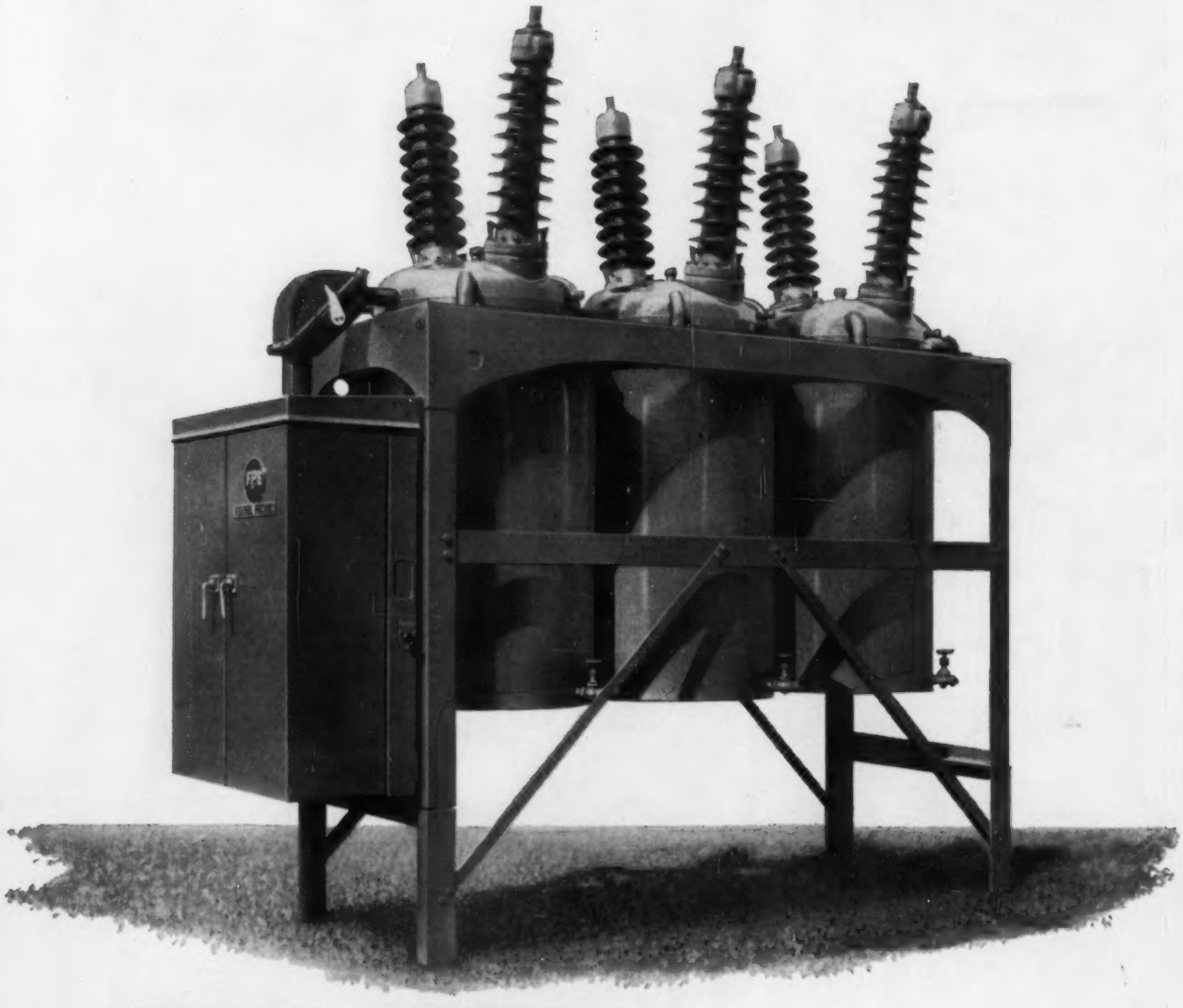
Specify power transformers that are designed, built and proven to give efficient, dependable performance . . . Specify Moloney Transformers, All Along The Line.

MOLONEY ELECTRIC COMPANY

Manufacturers of Transformers for Utilities, Industry, and Electronic Applications

FACTORIES AT ST. LOUIS 20, MO. AND TORONTO, ONT., CANADA

FOR MORE DEPENDABLE CIRCUIT PROTECTION



FEDERAL PACIFIC
TYPE AF OIL CIRCUIT BREAKERS

...Designed to Interrupt High Current Faults in 23, 34.5, 46 and 69 KV applications

Compact...rugged...unrivaled in dependability —Federal Pacific's new high-capacity frame-mounted Oil Circuit Breakers embody the most advanced design features to provide unmatched performance and reliability. Employing a rugged, thoroughly-tested drop-bar contact structure, the new type AF is equipped with standard ASA bushings. Two bushing-type current transformers per bushing can be provided where necessary.

Powered by the advanced type OA hydraulic mechanism, they give fast, shock-free opening and closing...and are *100% trip-free under all conditions.* The mechanical linkage is characterized by a highly efficient straight-line-drive of greatly simplified design. Subjected to the most exhaustive testing procedure—the ability of the new breaker to withstand high-current fault interruptions has been thoroughly proved. For full details, call your nearest Federal Pacific engineering representative or write for Booklet #4-540: Pacific Switchgear Division, 5815 Third Street, San Francisco 24, Cal.

FEDERAL PACIFIC ELECTRIC COMPANY
Main Offices: 50 Paris Street, Newark, New Jersey

FEDERAL FPE PACIFIC

Better Products to Control Electricity

The Electrical Week

FUTURE NEWS ▶ **Watch for the birth of a public power organization** to promote the governmental development of the Potomac River Basin.

LATE NEWS ▶ **AIEE will have to make other plans** if Pittsburgh hotel strike goes beyond Oct. 17. Fall general meeting is to be held there at the Penn-Sheraton, Oct. 27-31.

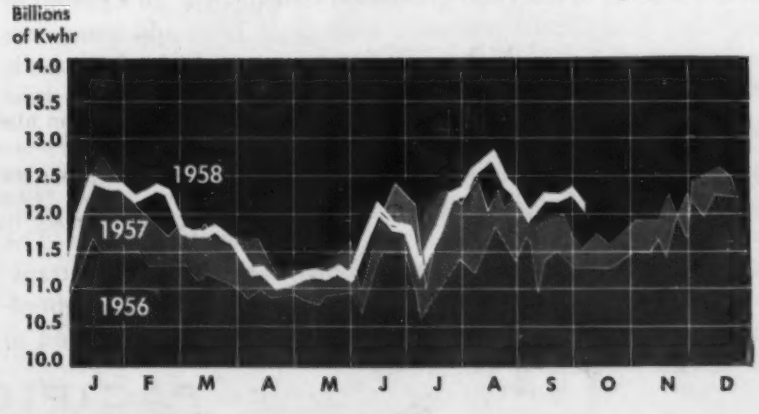
Pennsylvania P&L plans to sell its motor fleet to Commonwealth Plan of Boston, and then lease it back. Sale will reportedly give PP&L about $5 million permanent working capital to finance construction.

Atlantic City Electric intends to buy two electric-powered cars and one electric-powered truck. Cars will be from Stinson Tool & Engineering Corp, San Diego, Calif; truck from Cleveland Vehicle Co, Cleveland, O. Stinson will market the car on an area basis in San Diego, New Jersey and Los Angeles in '59, and nationally in 1960.

Toledo Edison submits bid to buy village-owned power distribution system in Genoa, Ohio, offering $262,501. Citizens will vote on the proposal Nov. 4.

Management changes . . . B. C. Electric elects two vp's: J. H. Steede and J. J. Carson . . . Foster Wheeler ups W. L. Martwick to president, succeeding E. W. Mills, now chairman, and J. E. Kenney to exec vp . . . Louisville G&E promotes B. H. Milner to exec vp . . . Federal Pacific elects T. M. Cole president, succeeding J. S. Thompson, new honorary chairman . . . At W. H. Salisbury & Co: T. R. Claffy to chairman, G. F. Salisbury to president, and W. H. Salisbury to vp and treasurer . . . G. E. makes J. S. Smith general manager, outdoor lighting department, Nov. 1 . . . Wahkiakum County PUD makes A. L. Hendrickson manager, succeeding J. S. Dickson, resigned because of ill health.

POWER OUTPUT—UP 4.7% (Week ending Oct. 4), Kwhr 12,111,000,000



Per Cent Change From Previous Year

	Sept. 20	Sept. 27	Oct. 4
Total U. S.	+2.1	+5.5	+4.7
New Eng.	+2.7	+5.1	+5.4
Mid. Atlantic..	−0.8	+3.5	+4.5
Cent. Ind.	+2.0	+4.9	+3.8
West Cent. ..	+4.4	+8.2	+5.0
Southeast	+2.1	+4.2	+4.4
South Cent. ..	+4.3	+19.6	+8.2
Rocky Mount..	+5.6	+6.2	+4.7
Pacific			
NW	−3.2	+0.9	−0.9
SW	+5.6	+1.7	+9.2

Seasonally Adjusted Index 234.2
Week Ago 238.9 Year Ago 222.8

Source: Edison Electric Institute

A TWO-MINUTE PREVIEW OF THIS ISSUE

EVENTS ▶ **Southeastern Electric Exchange's study on utility usage** in military housing projects was presented to government officials recently. The study, not a point-by-point rebuttal of the gas industry's "Zinder Report", lists additional factors which must be considered in evaluating utility services in multiple housing projects. Cost estimates for services to 1,000 units at five different armed forces bases were included. Demands of military personnel for higher living standards, an important reenlistment factor, must be considered, SEE representatives say. An analysis of the report appears on **p 60.**

The growth of utilities hinges on public understanding and the ability to earn enough profits to attract capital, delegates to the Northwest Electric Light & Power Association annual convention were told. Experiences of utility executives on their recent Russian visit also highlighted the Sun Valley meeting **(p 66).**

GENERATION ▶ **A huge net traps fish at Brownlee Dam.** Idaho Power Co doesn't keep them, though. Fish induced into "skimmers" are pumped ashore, transported downstream by truck, and released below Oxbow Dam, farther down the Snake River **(p 64).**

SPECIAL REPORT: MODERNIZATION OF TRANSMISSION ▶ **Modernize transmission to balance system capacity.** The second of Electrical World's five special reports examines the impact of obsolescence on transmission systems and evaluates the means available to combat it. It's all part of McGraw-Hill's "Plan '59"—urging the nation's industries to modernize now for growth and profits. Here are the four articles on transmission:

Are today's transmission systems obsolete? Many are, and the pressure of increased generating capacity is making them more so. Available rights of way are being severely crowded. Average size of new generating units has doubled in the last five years, and much larger blocks of power must be carried greater distances. Sweeping design changes are being made to keep pace with explosive system growth **(p 68).**

How are loading of lines and generation coordinated? In a period of rising costs coordinated economic loading of lines and generators offers opportunities for big savings. Five major methods of economic loading are described and their applications outlined. Here's how utilities feel about different operating methods **(p 72).**

What can be done about lines and rights of way? Many companies have found that rebuilding and reconductoring offer the only practical solutions for the problem of the diminishing right of way. The trend to higher voltages continues as means are sought for transmitting the maximum amount of power over the minimum right-of-way area. Here are the answers that a number of utilities found to their specific problems **(p 74).**

How can transmission substations be improved? Design engineers are taking a long look at opportunities for substation modernization. Improvements in design and circuit arrangement have been rapid in the last few years. All-aluminum substations are becoming more common, and experience has been generally favorable. Capacitor installations have proved economical in several locations. New applications of protective relaying have helped stabilize systems (p 79).

MANAGEMENT ▶ **Electric utilities are pushing a substantial research program.** In addition to the tremendous quantity of research carried on in their behalf by electrical manufacturers, utilities are involved in not less than 968 research projects of their own. EEI's Research Projects Committee discovered this in a recently-completed two-year survey of member companies. For a rundown of what the industry itself is doing in research, turn to p 121.

SELLING ▶ **Tampa Electric has opened an appliance service center.** Although the company does not advertise servicing in competition with local dealers, business has been brisk. The installation features year-round air conditioning through the use of heat pumps (p 118).

MANUFACTURERS ▶ **The latest transformer for underground distribution systems** mounts above ground. The totally-enclosed unit is built by RT&E . . . Preformed Line Products has a mobile lab for field study of vibration effects on transmission lines . . . Neoprene-lined stringing sheaves will soon be available from Sherman & Reilly . . . GE reports reducing transformer losses 10%. A new line will be smaller, lighter than previous models . . . Allis-Chalmers design changes have produced smaller, lighter, more compact vault transformers (p 86).

NEW EQUIPMENT ▶ **Insulation stripper peels linear polyethylene** and other hard to remove insulations without damaging conductor . . . Aerial lift has outer boom of Spiralloy insulation for safety in line work . . . Streetlight control without tubes, transistors or transformers handles all photoelectrically controlled equipment (p 104).

PEOPLE ▶ **New England Electric System makes management changes.** Edward G. Bower will be vp and general manager of Merrimack-Essex Electric Co, Edward F. Ziegler is New England Power Service Co vp, Guy W. Nichols, Jr, moves up to vp and manager of the Southern Berkshire Power & Electric Co, and William F. Seymour is new area development manager of the system . . . Public Service Co of Indiana has elevated J. R. Dunigan, E. M. Gue, and R. C. Pattyn to vp's (p 129).

NEXT ISSUE ▶ **Modernize distribution and metering for tomorrow's requirements** will be the theme of next week's special report on modernization. The report will examine present systems, evaluate trends in modernization, and point out the extent to which utilities are meeting the challenge.

Solid state physicists boast that they can design materials with prescribed physical properties. To them the design of materials with a high thermoelectric efficiency presents a real challenge. Their response to this challenge will give us materials which will find application in nearly every field of technology. Society will reap rich benefits from such new materials, other than the thermoelectric application for which they were originally created.
—Dr. Clarence Zener, Westinghouse Electric Corp, at U. S. Naval Research Laboratory Symposium.

TECHNICAL NOTES

Best geometrical shape for a nuclear reactor core is a sphere. It minimizes neutron leakage and hence the amount of uranium in the core because for this shape the ratio of surface area to volume is small. But the practical choice for the core shape lies between a cube and right cylinder because of the need for inserting and withdrawing fuel elements and for the coolant to pass through the fuel element arrangement.

Fly ash used as a pozzolanic material in mass concrete need not have a low carbon content provided other characteristics, such as fineness and silica-alumina balance, are good.

Radioactive elements in the upper 40-50 miles of the earth's crust continually release heat that is equivalent to power generation of 190,000 Mw.

Strength of fly ash concrete at later ages is higher than plain concrete; temperature change due to hydration and volume change due to setting are relatively little. Freezing and thawing durability of the concrete is unimpaired by the use of fly ash.

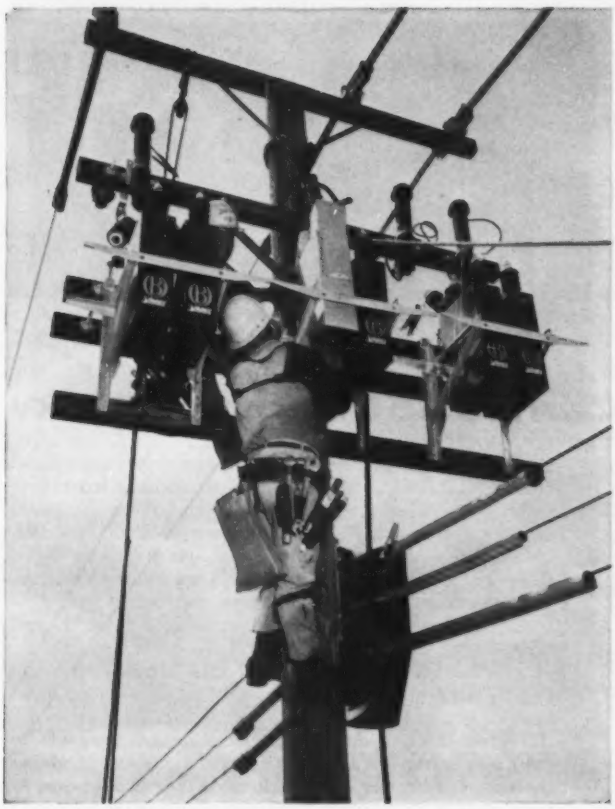
FROM EDITORS IN THE FIELD

Computers are used to estimate future electric power requirements in the French utility industry.

Asphaltic concrete has been successfully used as a water tight deck on the upstream face of the rock-filled Montgomery Dam in Colorado.

Up to 12 Inches Extra Clearance at Pole Top

Provided by Low Height of VAREX Capacitor, and Central Lifting Eye



Low height of Varex, plus inches saved by lifting eye location, provides extra clearance, often eliminates need to move primary.

Just a few inches can make a critical difference when capacitors are being installed on distribution lines. To get the necessary clearance for moving the capacitors under the primary and into the rack, it's often necessary to move the primary with hot sticks . . . with a considerable loss in time.

Varex capacitors give you as much as 12 extra inches of clearance at the pole top. Often they can mean the difference between merely covering the primary and the need to move it completely out of the way.

Here's where the difference comes from.

First, Varex 50-KVAR capacitors are as much as five inches lower than other brands.

Second, the Varex lifting eye is centrally located between the bushings. There's no need to put a complicated sling arrangement around the unit. A hook, clevis, shackle, or whatever attaching device you prefer, can go right down between the bushings. The result: a gain of another six to eight inches in clearance.

It's obvious that designers of Varex capacitors understood your installation problems. Everything has been done to make installation fast and easy.

OHIO BRASS COMPANY, MANSFIELD, OHIO

Central lifting eye lets capacitor hang straight, making it easy to maneuver.

Ohio Brass

4873-H

Installing the self-cooled isolated phase bus structure to carry 6500 amps at 20 kv from the generator to the power transformers at Steam Turbo-Generator Unit #3 at the Astoria Station of the Consolidated Edison Co. The tubular copper bus, 13½" O.D., .406" wall thickness, is wrapped with black insulating tape prior to installation.

Big Tubular Copper Bus Carries 6500 amps at 20 kv

At its #3 Steam Turbo-Generator at Astoria, L. I., the Consolidated Edison Company uses these large Anaconda tubular copper conductors to carry generator output to the power transformer. These special conductors are another example of how Anaconda can help meet special conditions. Though well beyond the standard-pipe-size copper bus tube, they are by no means the largest. Anaconda can produce seamless copper tubes up to 26 inches, I.D.

13½" O.D. x .406" tubular bus being fabricated at R & I E Equipment Div. of I-T-E Circuit Breaker Co., Greensburg, Pa. Everdur® nuts are silver-alloy brazed inside the tube and the bolts withdrawn. Then in assembly at the site, the nuts are in place for fast, easy installation. A total of 1,128 feet of tubular bus was required.

In general, where mechanical requirements permit, bus costs can be cut through the use of tubular bus conductors with low wall-thickness-to-diameter ratios. The weight of metal purchased goes down as the t/d goes down. Round tubes in the standard pipe dimension, and thin-wall sizes, also offer other advantages. They make it possible for you to utilize the great variety of stock sizes of supports, connectors, clamps, and other line hardware.

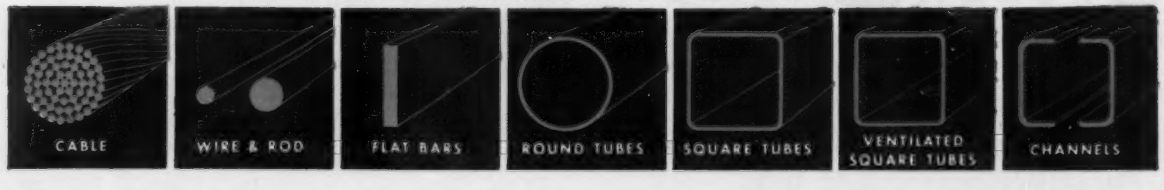
TECHNICAL SERVICES. Anaconda specialists are available to help you in the solution of technical problems involving the use of Anaconda Bus Conductors. For such service, or for a copy of Publication C-25, see your nearby Anaconda representative. Or write: The American Brass Company, Waterbury 20, Conn.

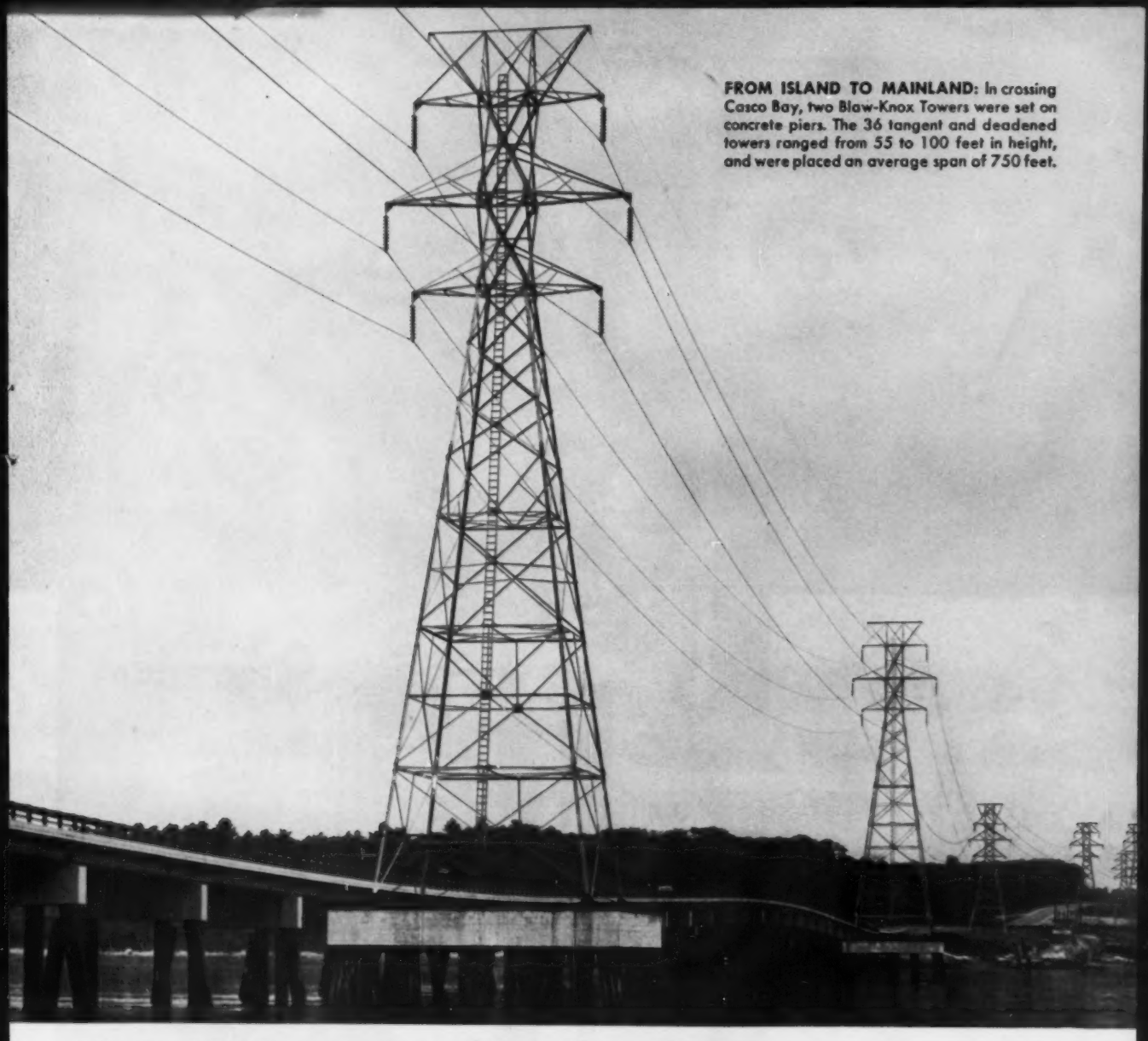
ANACONDA®

COPPER CONDUCTORS

Made by The American Brass Company

THERE'S AN ANACONDA ELECTRICAL CONDUCTOR FOR EVERY NEED





FROM ISLAND TO MAINLAND: In crossing Casco Bay, two Blaw-Knox Towers were set on concrete piers. The 36 tangent and deadened towers ranged from 55 to 100 feet in height, and were placed an average span of 750 feet.

Central Maine chooses Blaw-Knox Towers to carry lines from new Cousins Island Plant

The new Yarmouth Steam Plant—the newest and potentially the largest in Maine—is the latest development by Central Maine Power Company to meet the increased needs of its growing number of customers. The new showcase plant will use two 44,000 kw turbine-generators along with the latest and largest transformers and condensers in the state.

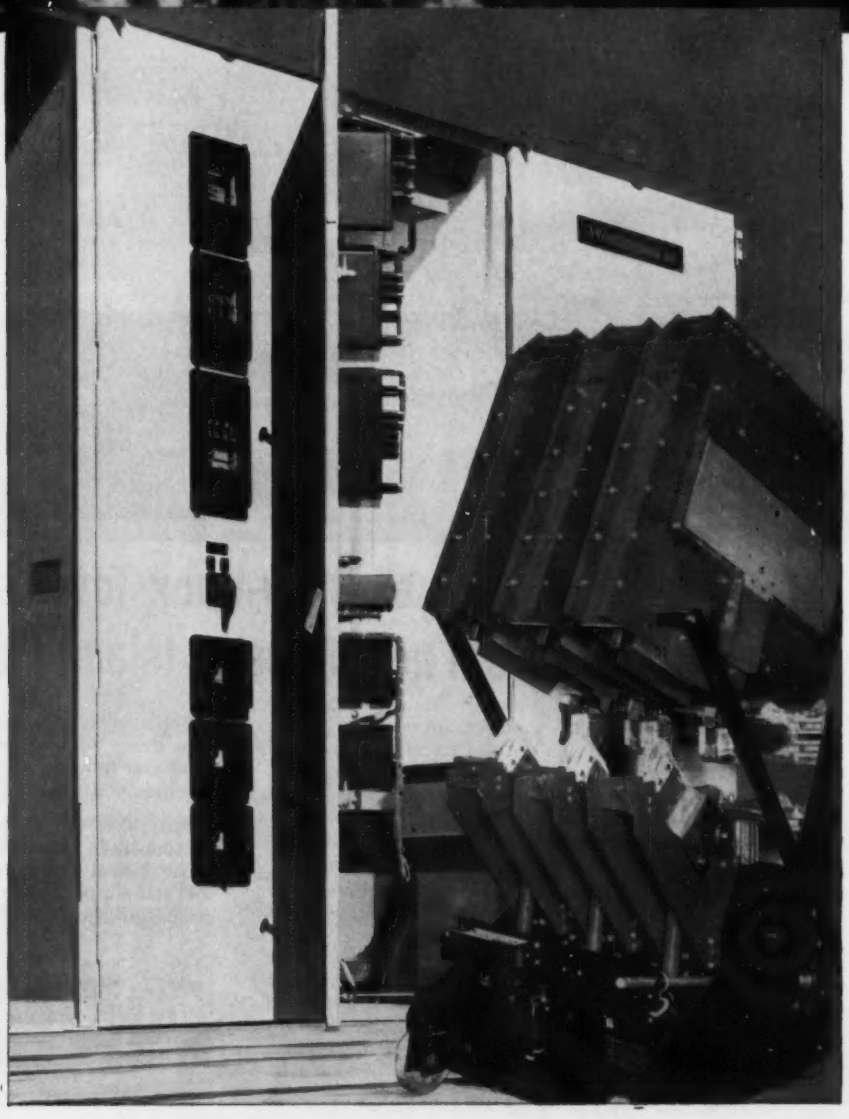
To carry the 115,000 volt lines from Cousins Island to the Moshers substation in Gorham, Blaw-Knox designed and fabricated 36 steel transmission towers. Working with Central Maine's engineers Blaw-Knox was able to bring over 40 years of transmission tower experience to the job. Basic concepts evolved from this extensive experience are used to build towers that are superior in strength, simpler to erect, easier to modify.

See how this background can pay off in meeting your own tower requirements. For details, send for Folder 2509 and tell us your needs. We'll gladly give you our recommendations and a quotation.

Transmission Towers—Steel Transmission towers, custom-built for each installation . . . multi-circuit and other special structures . . . and antenna towers, guyed and self-supporting types for AM • FM • microwave • communications • radar • parabolic antennas

BLAW-KNOX

BLAW-KNOX COMPANY
Equipment Division
Pittsburgh 38, Pennsylvania



The 150-DH-1000 Breaker is easily removed from its cell for contact inspection or replacement. Breakers are drawn out horizontally, with no lifting or lowering. A few turns of a simple crank device on the front of the assembly move the breaker from the test to the operating position.

Plowback of Earnings into Research brings you Metal-Clad Switchgear with

15-KV AIR CIRCUIT BREAKER HAVING 1-MILLION-KVA INTERRUPTING CAPACITY

The 150-DH-1000 Breaker, with 1200 and 3000 continuous ampere rating, helps solve the problem of ever-increasing load concentration—particularly of utilities in large metropolitan areas.

In addition, this increased capacity is coupled with the exclusive Westinghouse De-ion® principle of arc extinction . . . fastest and most efficient method ever devised. The H-type iron circuit creates a strong and uniform magnetic field. The blowout coil in the center, in series with the arc, actually splits the arc in two, giving the effect of two interrupters in series in each arc chute.

Main contacts are self-aligning, multiple line, butt type. To provide easy accessibility for inspection and maintenance of contacts, the arc chutes are hinged at the rear, and a simple, easy-to-use tilting attachment is provided. Contacts are at convenient working height.

These features mean you'll be better able to handle larger loads *safely* in metropolitan generating substations and to realize greater economy in utility and industrial substations of high capacity.

For full information about 150-DH-1000 Breakers or SHELTERFOR-M, call your Westinghouse Representative, or write Westinghouse Electric Corporation, P.O. Box 868, 3 Gateway Center, Pittsburgh 30, Pa.

OUTDOOR MAINTENANCE COMES INSIDE WITH . . .

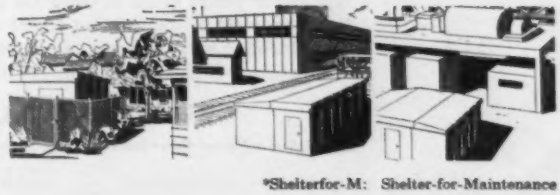
Shelterfor-M* Metal-Clad Switchgear

Westinghouse SHELTERFOR-M is designed to protect both equipment and personnel from the weather. Inside working areas are roomy, all equipment is easily accessible for servicing. Clean, modern lines make SHELTERFOR-M adaptable to suburban community surroundings. SHELTERFOR-M offers easy flexibility for growing loads and system expansion without costly construction and alterations.

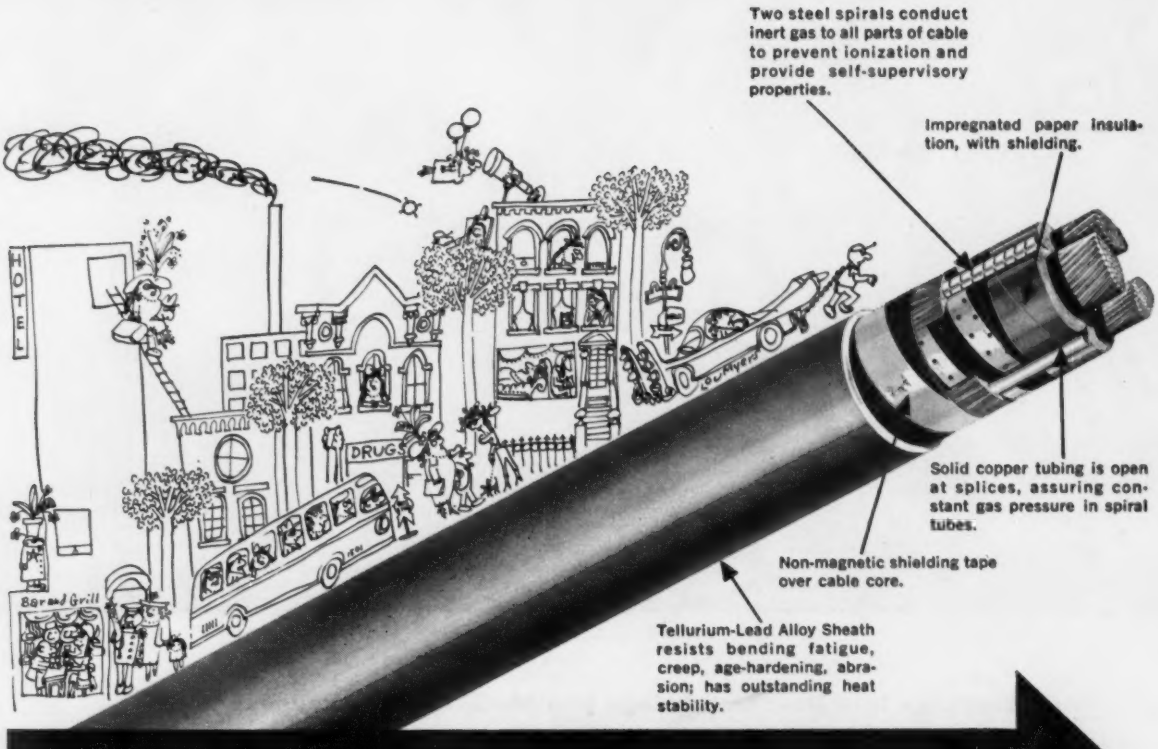
J-60942

YOU CAN BE SURE...IF IT'S

Westinghouse



*Shelterfor-M: Shelter-for-Maintenance


Two steel spirals conduct inert gas to all parts of cable to prevent ionization and provide self-supervisory properties.
Impregnated paper insulation, with shielding.
Solid copper tubing is open at splices, assuring constant gas pressure in spiral tubes.
Non-magnetic shielding tape over cable core.
Tellurium-Lead Alloy Sheath resists bending fatigue, creep, age-hardening, abrasion; has outstanding heat stability.
DRUGS
Bar and Grill

KEEPS UPHILL POWER "ON THE LEVEL"!

ROEBLING
GAS-FILLED CABLE

What happens when solid-type cable is used on steep grades? If you've used it, you know! The oil impregnant simply obeys the law of gravity and drains to the bottom of the grade. At the low point, hoop stress (caused by oil pressure build-up) makes the lead sheath stretch. Eventually a rupture occurs. And in the areas drained of oil, ionization takes place.

What's the answer to this constant (and inevitable) problem? *Roebling Low-Pressure Gas-Filled Cable*—for voltages up to 46 kv! Dry nitrogen gas, inside this cable at approximately 12 psi pressure, provides consistent dielectric properties throughout the length of the cable. No matter how steep the grade, internal pressure is uniform everywhere.

Another feature of this cable is that it is self-supervisory—an alarm system lets you know if there's trouble along the line.

Roebling Low-Pressure Gas-Filled Cable is as easy to splice as solid-type paper power cable. It offers the least expensive long-term answer to the problem of transmitting power uphill! Get the whole story from your Roebling Field Representative soon. Electrical Wire Division, John A. Roebling's Sons Corporation, Trenton 2, New Jersey.

ROEBLING

Branch Offices in Principal Cities • Subsidiary of The Colorado Fuel and Iron Corporation

Production Line QUALITY CONTROL...

...makes certain that every Porcelain Products Insulator you buy is a "carbon copy" of the proven master design

Porcelain Products Suspension Insulators are designed to meet the industry's most rigid requirements for mechanical strength, insulation, and durability. To make certain that you get these essentials in every Porcelain Products Insulator you buy—plant-wide quality control is used to check *every* process, *every* part, *every* insulator throughout the production cycle.

Quality control begins with rigid inspection of all incoming raw materials, and continues with *constant production line tests and inspections*—high and low frequency electrical tests, dimensional checks, porosity tests, combined mechanical and electrical strength tests, impact tests, thermal shock tests, radio interference tests, oil puncture tests and many others.

This complete quality control program on the production line is your guarantee that every Porcelain Products Insulator you buy duplicates the master design.

Illustration above shows insulators being given a production line 5 minute, 60 cycle shell test and a 5 second high frequency 200 KC test. The cutaway view shows construction features of Porcelain Products No. 66255 ten inch Suspension Insulator.

PORCELAIN PRODUCTS, INC. PARKERSBURG, W. VIRGINIA

P58-1

A SUBSIDIARY OF A·B·CHANCE COMPANY

NEW UTILITY STATIONS, C-E EQUIPPED

Includes only new stations on *new* sites placed in operation since **JANUARY 1, 1950.**

LAKE CATHERINE
HUTCHISON
YATES
DUNKIRK
TITUS
LEE
CONTRA COSTA
HAWTHORN
NINEMILE POINT
EDGE MOOR
PALATKA
JOHNSONVILLE
DANSKAMMER
BECKJORD
HIGHGROVE
PLANT X
BLACK DOG
ALBANY
JOPPA
MERAMEC
PORTSMOUTH
LAKE CREEK
ETIWANDA
AURORA
HENNEPIN
EASTLAKE
OAK CREEK
SUWANNEE RIVER
URQUHART
KINGSTON
SANDOW
MULLERGREN
BARRY
NORTH OMAHA
WILMINGTON
CARBON
SAGUARO
MORRO BAY
VERMILION
JOHN SEVIER
COLLIN
MILLIKEN
GALLATIN
BARRETT
MITCHELL
SAN BERNARDINO
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GULF COAST
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PORT WENTWORTH
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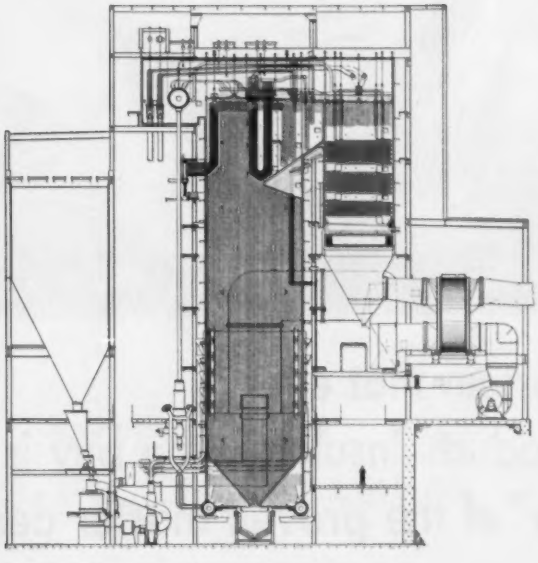
ALLEN

NEW ALLEN

Now in Service



The C-E Unit shown above is one of two duplicate units now in service for the Allen Plant of the Duke Power Company. Each of these units is designed to serve a 175,000 kw turbine-generator operating at a throttle pressure of 2400 psi with a primary steam temperature of 1050 F, reheated to 1000 F. They are of the controlled-circulation, radiant reheat type with convection reheater surface located between the primary and secondary superheater surfaces, and radiant reheater surface of the platen type intermeshed with radiant superheater platen surface at the top of the furnace. An economizer section follows the rear superheater section, and regenerative type air heaters follow the economizer surface. Pulverized coal firing is employed using bowl mills and tilting, tangential burners.

COMBUSTION

Combustion Engineering Building

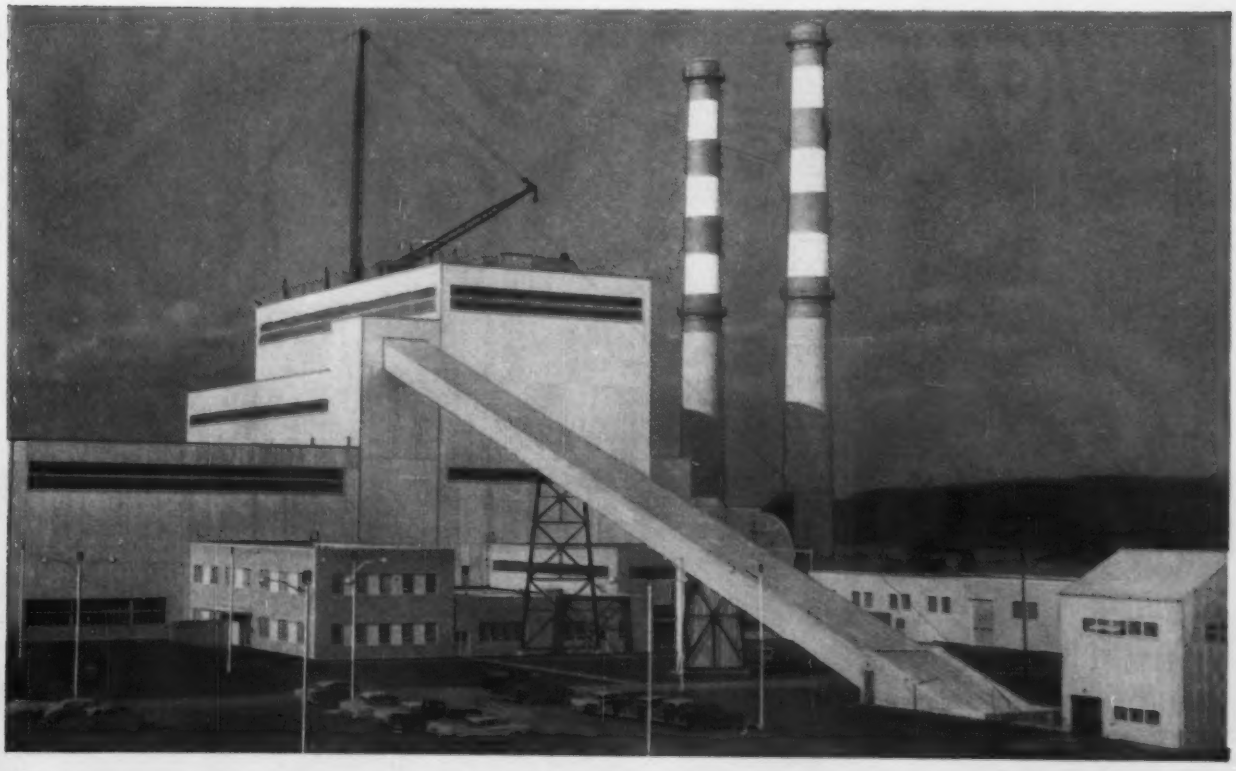
ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED

PLANT

The Duke Power Company now has Units No. 1 and No. 2 in service in a new station which is destined to become the workhorse of its system. The Allen Plant, named for Mr. George Garland Allen, First Chairman of the Board of the Company, is situated on the west bank of the Catawba River about five miles south of Belmont, North Carolina. It currently has two units in operation ... adding 350,000 kilowatts to Duke's system capacity. The plant represents an investment of some 41 million dollars, more than 1-million of which was spent to build a one-mile discharge canal for condensing water.

Units No. 1 and No. 2 at Allen are the sixth and seventh C-E Controlled Circulation Boilers in service in the Duke Power system. Construction of Allen No. 3 and excavation for No. 4—each with a capacity of 275,000 kilowatts—are already under way. A fifth unit is in the planning stage. When it is added, the plant's capability will exceed 1,000,000 kilowatts.

Steam for the new Allen turbine generators is supplied by C-E Steam Generating Units. A cross-sectional elevation and a brief description of their design appear on the opposite page.

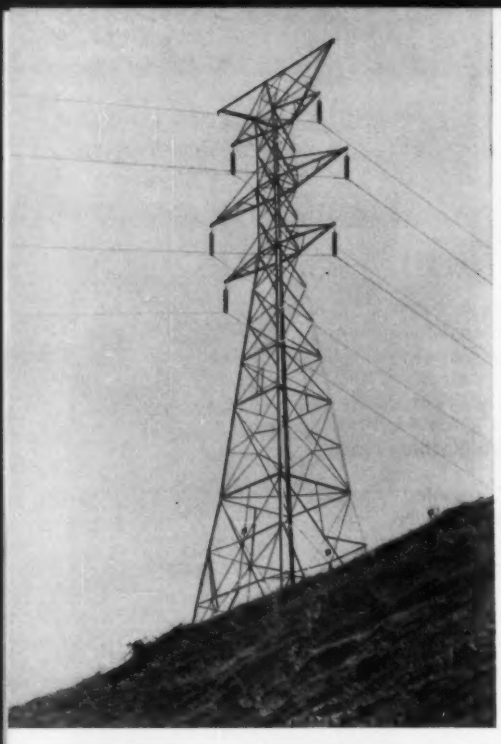


ENGINEERING

200 Madison Avenue, New York 16, N. Y.

C-177

EQUIPMENT; NUCLEAR REACTORS; PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE



Towers 2050′ apart

Specially designed towers solve tough location problems for Public Service Co. of Indiana, Inc. —a customer of American Bridge since 1940

Transmission towers on the hills near the New Albany generating plant.

support 4 tons of conductor!

To support 132 kv double-circuit transmission lines from its new power station at New Albany across 23.71 miles of countryside, the Public Service Company of Indiana, Inc. used 121 towers designed and fabricated by American Bridge. None of these towers are less than 100′; some are 110′ and 120′ tall.

In skirting the town of New Albany, it was necessary to go through a particularly rough and hilly section with elevation changes as great as 400′ and with distances between peaks ranging from 400′ to 2050′.

Since the line consisted of six high-voltage conductor wires, weighing an estimated 20,802 pounds per mile, those towers which were 2050′ apart had to be strong enough to safely support 4 tons. *And, when loaded with ice, the weight could be twice as heavy.*

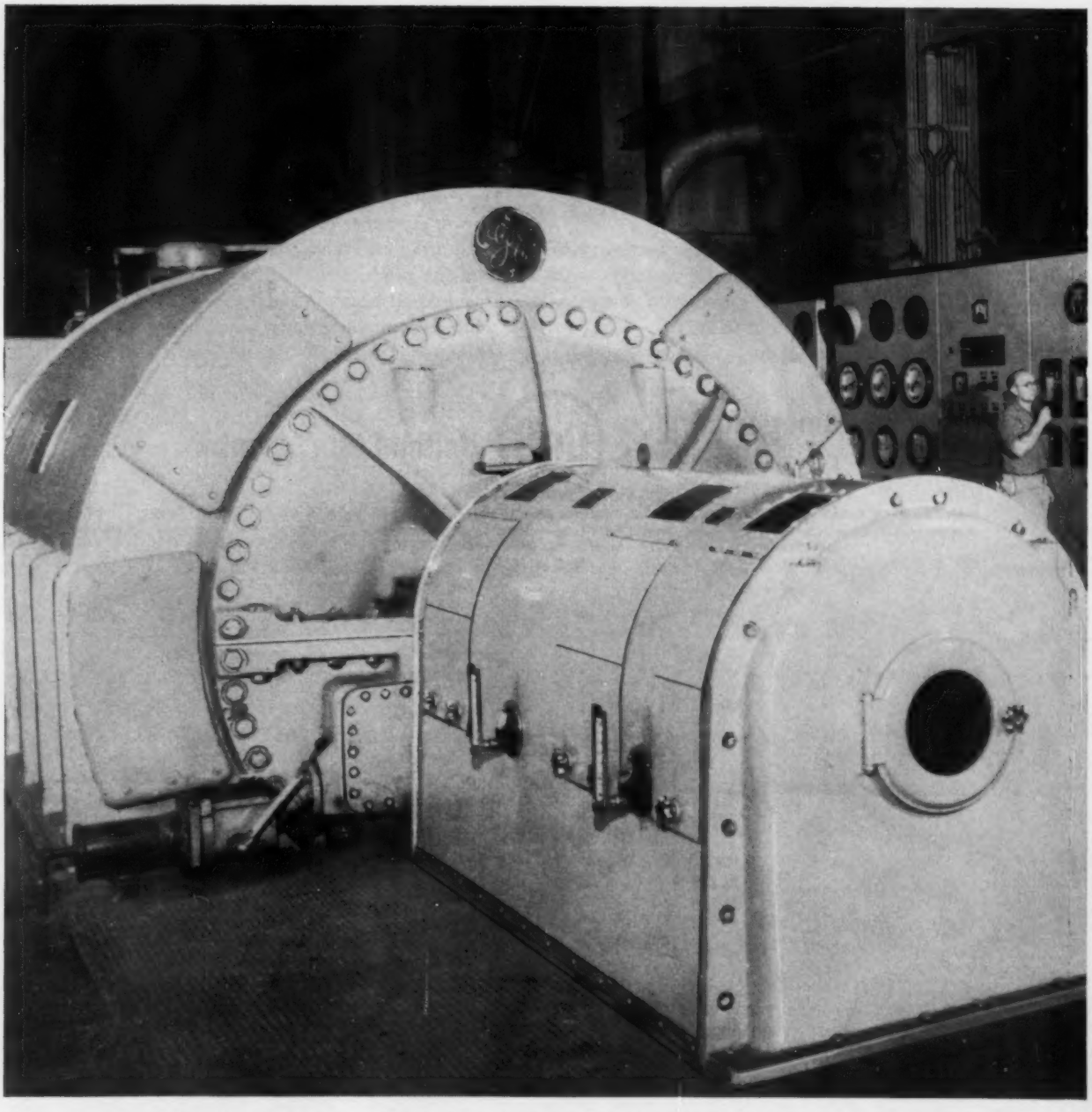
The Public Service Company of Indiana, Inc. has been a tower customer of American Bridge since 1940. This latest order is in recognition of the fine service received from the product itself, and the good relations which have existed between the companies.

For recommendations based on your specific requirements, just write our nearest office.

USS is a registered trademark

American Bridge Division of USS United States Steel

General Offices: 525 William Penn Place, Pittsburgh, Pennsylvania. Contracting Offices in: Ambridge • Atlanta • Baltimore • Birmingham • Boston • Chicago • Cincinnati Cleveland • Dallas • Denver • Detroit • Elmira • Gary • Houston • Los Angeles • Memphis • Minneapolis • New York • Orange, Texas • Philadelphia • Pittsburgh Portland, Ore. • Roanoke • St. Louis • San Francisco • Trenton • United States Steel Export Company, New York



No downtime due to oil failure in 17 years! More proof that

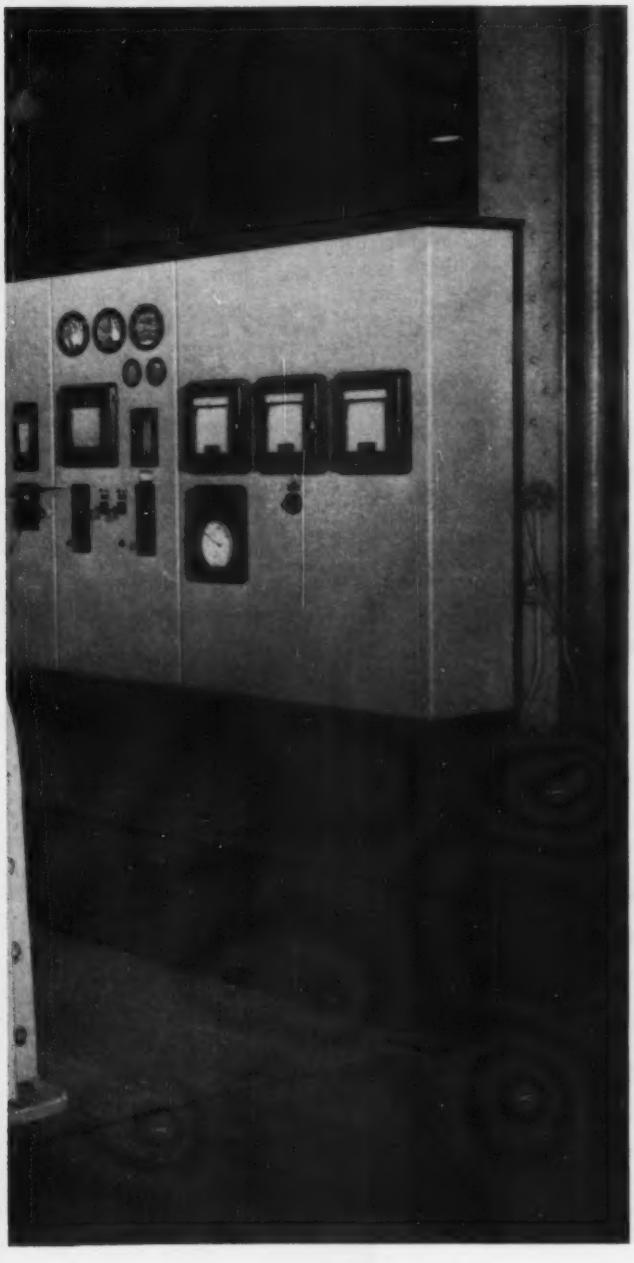
GULF MAKES THINGS

"During the last 17 years we have been using Gulfcrest turbine oil in all units and have had absolutely no difficulty with any of them due to oil failure."

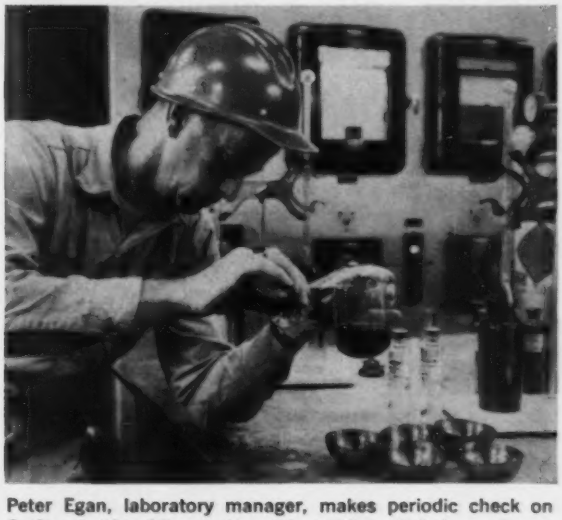
An outstanding record? Yes, and the authority is Mr. B. H. Cheeseman, Supervisor of Operations at the Deepwater Power Station, Atlantic City Electric Co., Penns Grove, N. J. "And," he continues, "in that entire period our laboratory tests have consistently shown that the oil is stable, non-foaming, free of sludge and rust. Neutralization numbers are consistently low."

Mr. Cheeseman is not alone in agreeing that Gulf makes things run better. In Gulf's marketing area, more power is generated by central station steam turbines lubricated with Gulfcrest than with any other turbine oil.

Gulfcrest is the turbine oil produced by Gulf's exclusive Alchlor Process. This is an extra refining step.



B. H. Cheeseman (right), Supervisor of Operations, gets new lubrication recommendations from T. C. Park, Jr., Gulf resident manager.



Peter Egan, laboratory manager, makes periodic check on Gulfcrest. After 17 years the oil is still free of sludge and rust.

This 25,000 kw GE Turbine is one of five units (total, 230,000 kw) at Deepwater Power Station of the Atlantic City Electric Company. It has been lubricated with Gulfcrest for 17 years.

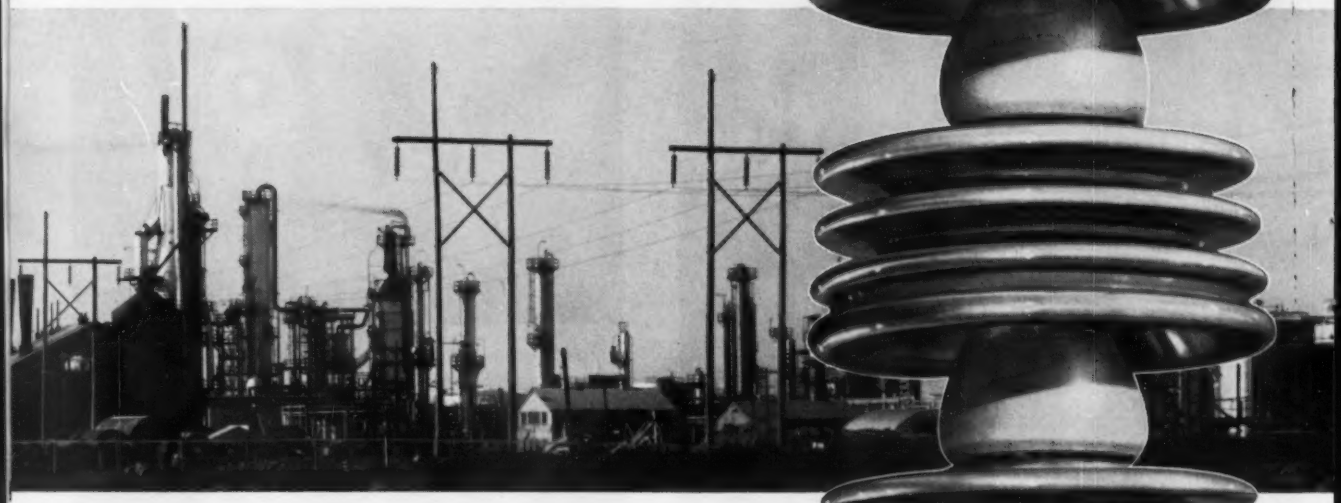
RUN BETTER!

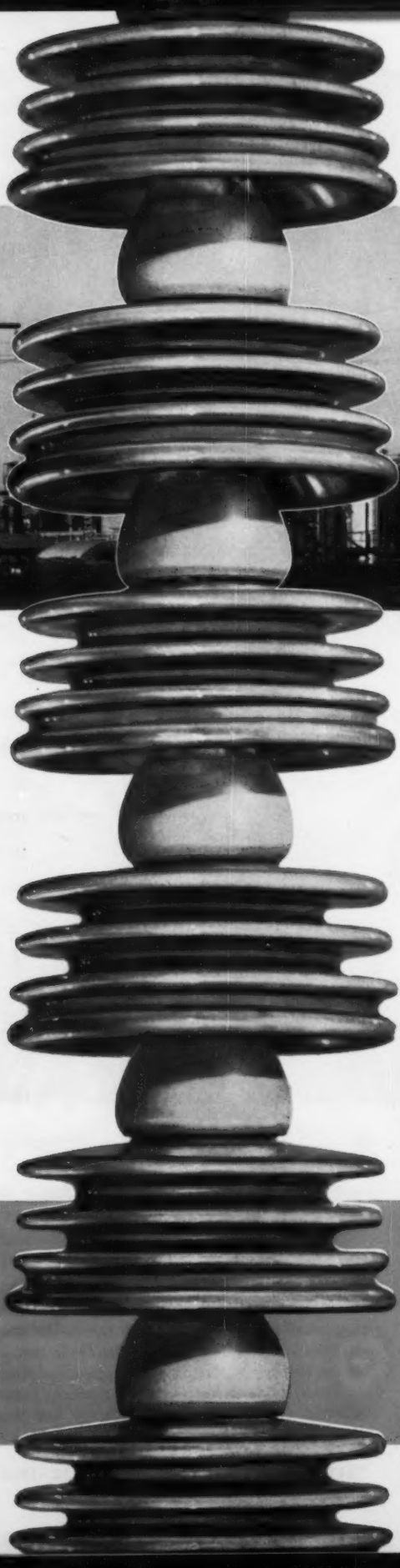
It weeds out harmful unstable hydrocarbons which remain after normal refining. If allowed to remain, these hydrocarbons could oxidize, form sludge, emulsifiers and harmful acids. Without them, Gulfcrest lasts longer, helps to keep turbine systems clean indefinitely.

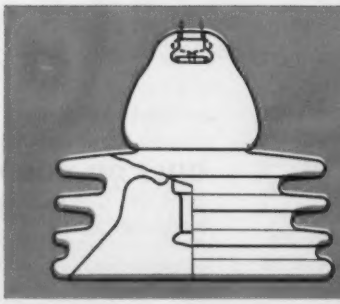
Your job is to keep your equipment functioning efficiently. Gulfcrest can help you do just that. A call to your nearest Gulf office will get you all the facts.

GULF OIL CORPORATION
Dept. DM, Gulf Building
Pittsburgh 30, Pa.

GULF







Standard-strength (15,000-lb.) Lapp Fog-Type suspension unit for 5¾" or 6½" spacing either ball-socket or clevis type

High-strength (25,000-lb.) Lapp Fog-Type suspension unit for 5¾" or 6½" spacing either ball-socket or clevis type

Contaminated atmosphere?
USE LAPP FOG-TYPES

THE DESIGN WITH 33 YEARS OF SUCCESSFUL SERVICE

Industrial fumes, salt-spray, dust, even automotive exhaust, continually coat your transmission lines with a conductive deposit. Where these conditions are excessive, prevention of insulator flashover becomes a prime operating and maintenance problem.

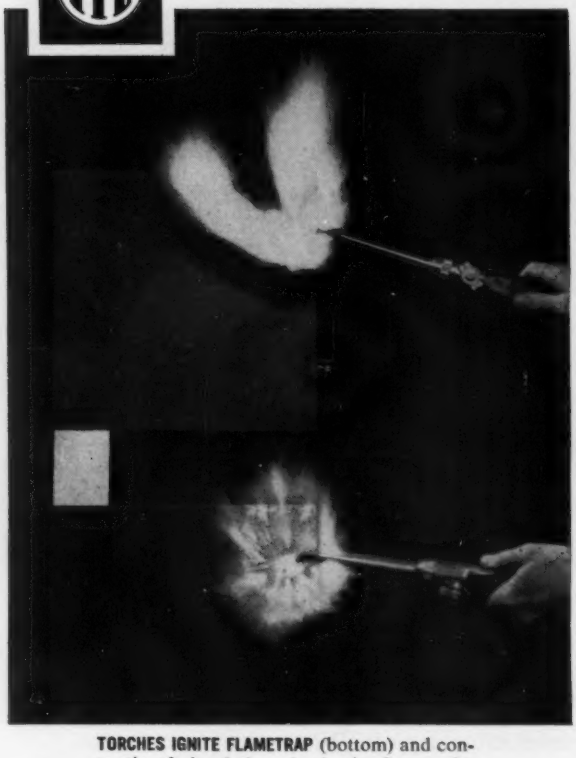
Lapp Fog-Type insulators offer a complete answer. Their design (a Lapp innovation more than 30 years ago) provides extra length of leakage path—and a *uniform* leakage path. Maximum exposure to contamination . . . to wetting . . . to cleaning action of wind and rain—distributes voltage evenly, prevents leakage flashover. Even in most areas of severe atmospheric contamination, Lapp Fog-Types require no cleaning—where they do, cleaning intervals are longer, and cleaning easier than on other types.

Forward utility thinking now calls for use of Fog-Type insulation on *all* lines in sea-shore or urban locations; it pays off in improved service records and lowered maintenance costs. And the specification of Lapp Fog-Type Suspension Units adds an extra margin of operating security and trouble-free long life.

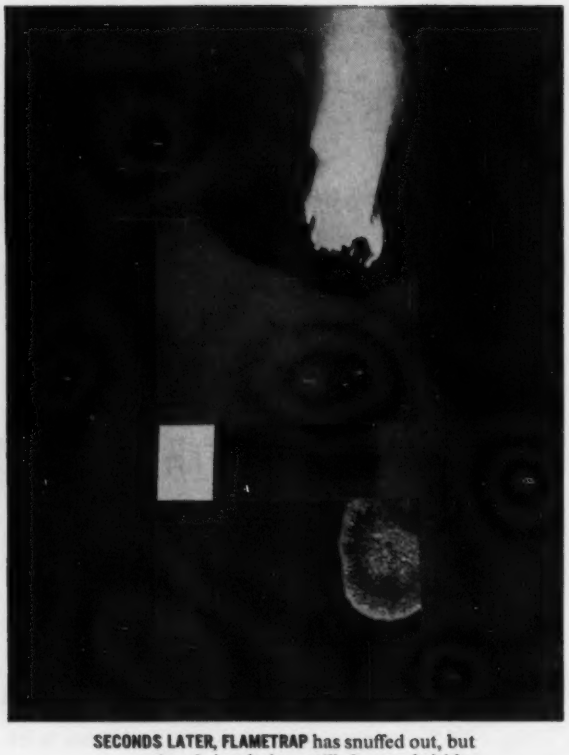
Lapp Insulator Co., Inc., Le Roy, N. Y.

Lapp

METAL-CLAD SWITCHGEAR



TORCHES IGNITE FLAMETRAP (bottom) and conventional insulation (top) simultaneously.



SECONDS LATER, FLAMETRAP has snuffed out, but conventional insulation still burns briskly.

New FLAMETRAP Insulation Snuffs Out Flame ...No Toxic Gases...Highest Arc Resistance

FLAMETRAP INTERPHASE BARRIER. Standard equipment on I-T-E 5 and 15 kv switchgear at no increase in price.

Take the heat away, and this new I-T-E developed FLAMETRAP insulation snuffs out . . . fast! This is today's most advanced flame-retardant insulation, and it is used exclusively in I-T-E Switchgear.

FLAMETRAP contains melamine resin—heretofore considered too expensive for commercial application. Unlike substitute ingredients, melamine gives off no toxic gases when it burns. So FLAMETRAP is far safer. And melamine stands up better under high temperatures. So FLAMETRAP suffers less from arc damage.

This latest improvement puts I-T-E switchgear even further ahead of the pack. It is one more of the quality details that keep coming your way from I-T-E without increase in price.

I-T-E service is as near as your telephone or mailbox. Why not call or write today. I-T-E Circuit Breaker Company, Switchgear Division, 19th & Hamilton Sts., Philadelphia 30, Pa. In Canada, Eastern Power Devices Ltd., Port Credit, Ont.

I-T-E CIRCUIT BREAKER COMPANY
PHILADELPHIA, PENNSYLVANIA

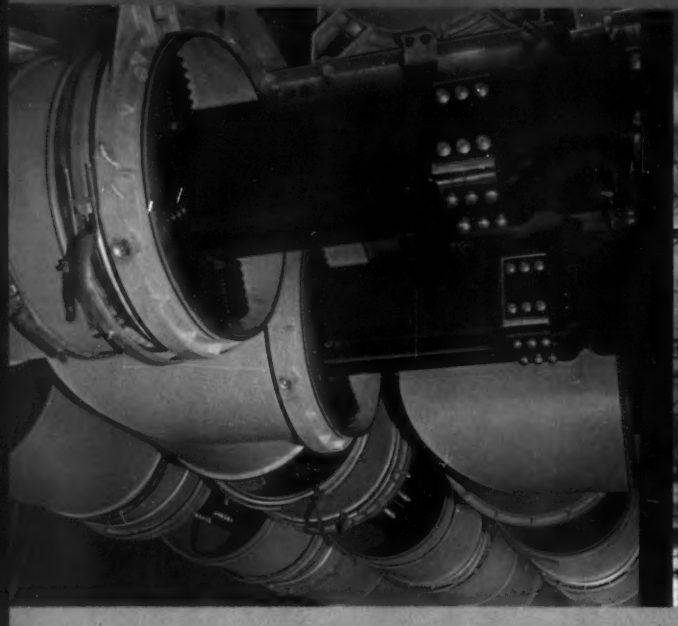
Pacific Gas and Electric Company's Morro Bay Power Station is an outstanding example of clean, modern lines achieved with ribbed walls of Alcoa Aluminum.

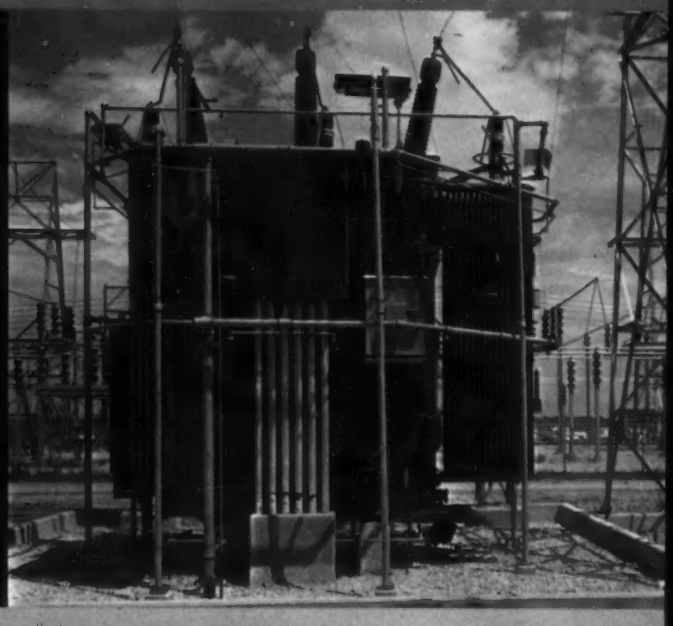
ALCOA RESEARCH

. . . development today for tomorrow's loads

HOW ALCOA ALUMINUM REDUCES COSTS IN GENERATING STATIONS

ALCOA'S THREE-PRONGED ASSAULT ON POWER STATION COSTS



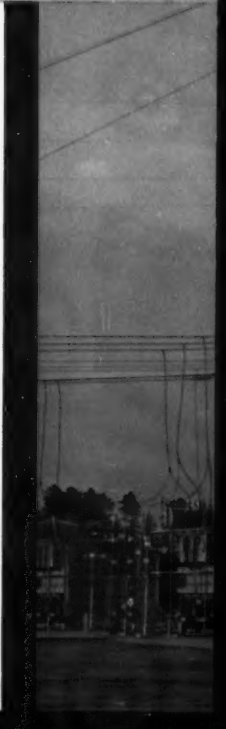


ARCHITECTURAL APPLICATIONS

There are three outstanding reasons why Alcoa Aluminum is the ideal building material for generating stations: low cost, freedom from maintenance and attractive appearance.

Walls of Alcoa Aluminum, uninsulated or sandwich type, go up fast. They require less supporting steel and a lighter foundation. They never need painting. Yet *sandwich wall of Alcoa Aluminum is the lowest cost, insulated metal wall system available.* Savings are also found in roofing, windows, conveyor framing and covers, handrails, grating, tread plate, fencing and many other applications. In every case, strong, lightweight Alcoa Aluminum offers a substantial bonus in corrosion resistance and permanent good looks.

Right: Maintenance-free beauty . . . Duke Power Company's Allen Plant at Belmont, North Carolina.



Through the years, Alcoa has adapted aluminum to new uses in power stations in three areas: electrical, architectural and mechanical. In every case, the objective has been the same: to reduce costs while advancing standards of performance. The result today is virtually an "all-aluminum" power station from conductors to condenser tubes, siding to stair treads. Everywhere you look, aluminum is helping utilities produce more kilowatts per dollar.

ALCOA ALUMINUM
ELECTRICAL CONDUCTORS AND ACCESSORIES
ALUMINUM COMPANY OF AMERICA

ALCOA RESEARCH

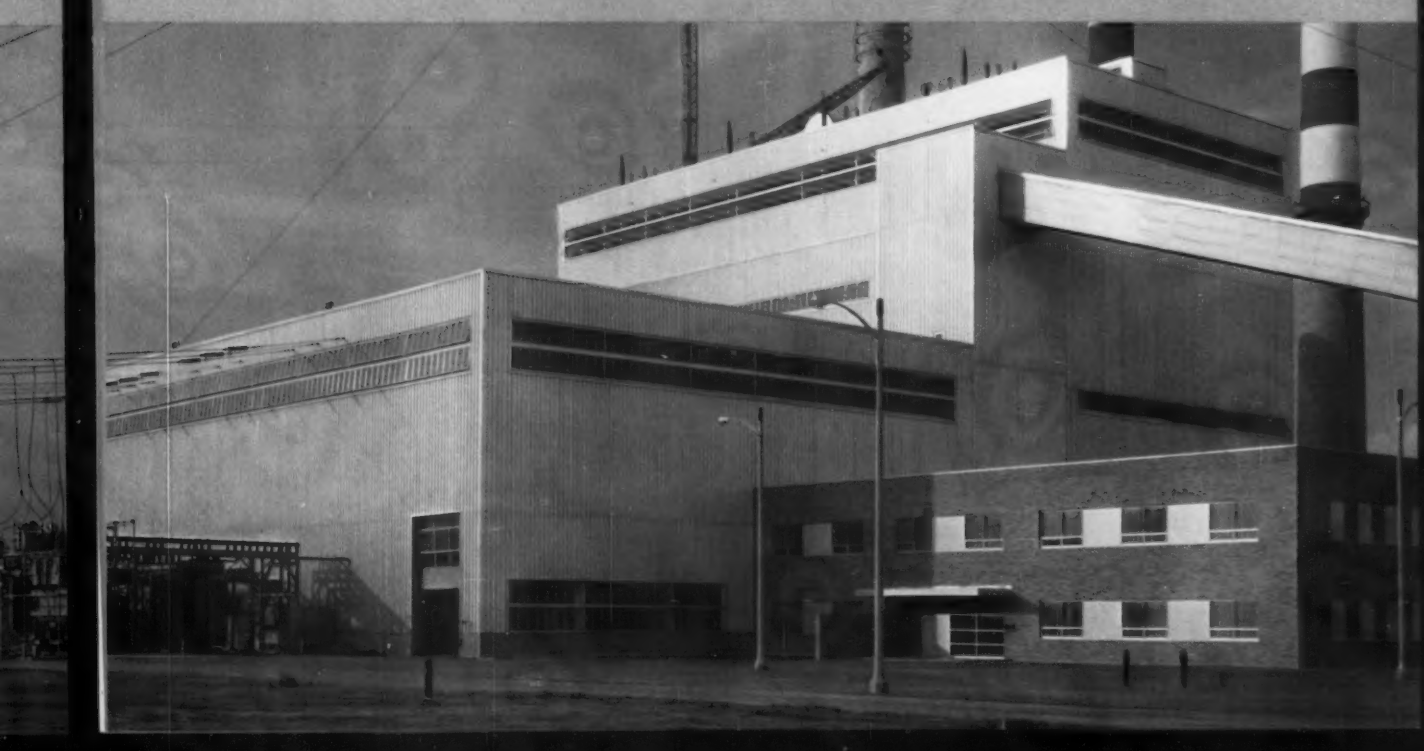
. . . development today for tomorrow's loads

ELECTRICAL APPLICATIONS

The same economy that accounts for almost universal acceptance of aluminum in overhead lines is yours if you specify aluminum for your power station. Alcoa® Bus Conductor, for example, is saving utilities many thousands of dollars, since an equivalent installation costs about one-half as much as copper. Conduit, crossarms and structures, cable, generator field windings, switchgear and isolated phase bus and enclosures, transformer windings and yoke end plates all represent opportunities for savings with Alcoa Aluminum. Soon transformer tanks and radiators will be available in aluminum. All these applications pay major dividends in lower maintenance costs, longer life and higher efficiency.

Left: Alcoa Rigid Conduit is used on this transformer at Kansas City Power & Light Company's Montrose Steam-Electric Generating Station.

Far left: Isolated Phase Bus made by Delta Star Division of H. K. Porter Co., Inc., with Alcoa Integral Web Channel Bus connected with aluminum bolts, aluminum enclosures and cast aluminum support rings at Commonwealth Edison Company's Fisk Station.

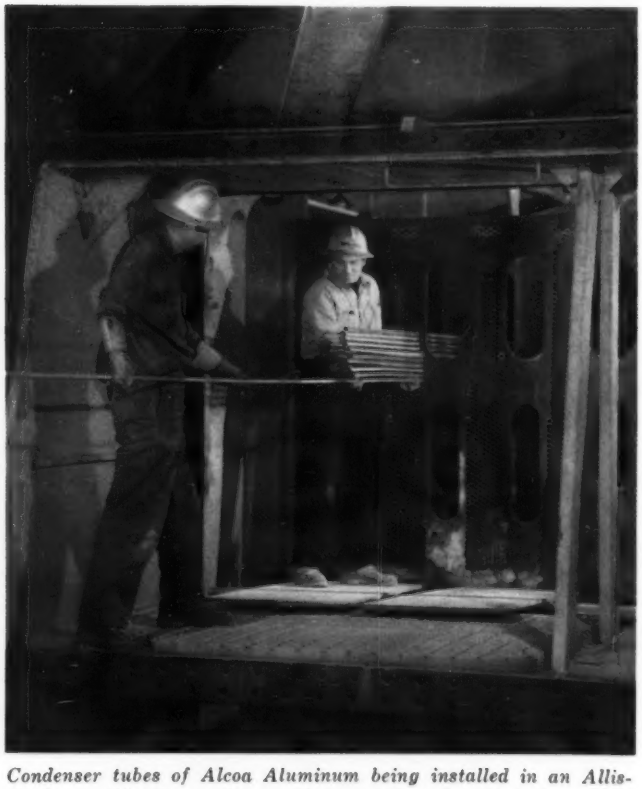


MECHANICAL APPLICATIONS

Among the foremost mechanical applications of aluminum are heat exchanger tubes. Low cost, as much as 50 to 60 per cent below other tubes, is combined with long life and superior resistance to carbon dioxide, hydrogen sulfide and ammonia. Moreover, heat transfer characteristics are equal to the best of competitive metals.

Aluminum's resistance to corrosion also accounts for major economies in condensate storage tanks, since no maintenance is required inside or outside and no iron is introduced into boilers.

In numerous applications including control tubing, tanks, covers, boiler lagging, jacketing, panels, canopies and low-pressure feedwater heaters, aluminum can help utilities to save on initial cost, on maintenance, through longer service—or all three.



Condenser tubes of Alcoa Aluminum being installed in an Allis-Chalmers Mfg. Co. surface condenser at The Detroit Edison Company's St. Clair Station.

Find out more about the use of aluminum in power stations. *Alcoa Aluminum for Generating Stations* is a new booklet listing many of the latest applications of aluminum in this field—electrical, architectural and mechanical—and containing a complete list of all Alcoa literature available on each of these subjects. It's "must" reading for every cost-conscious utility executive. For your copy, write Aluminum Company of America, 2301 Alcoa Building, Pittsburgh 19, Pennsylvania.

For more information on *any* application of aluminum in the electrical industry, call Alcoa.

ALCOA ALUMINUM
ELECTRICAL CONDUCTORS AND ACCESSORIES
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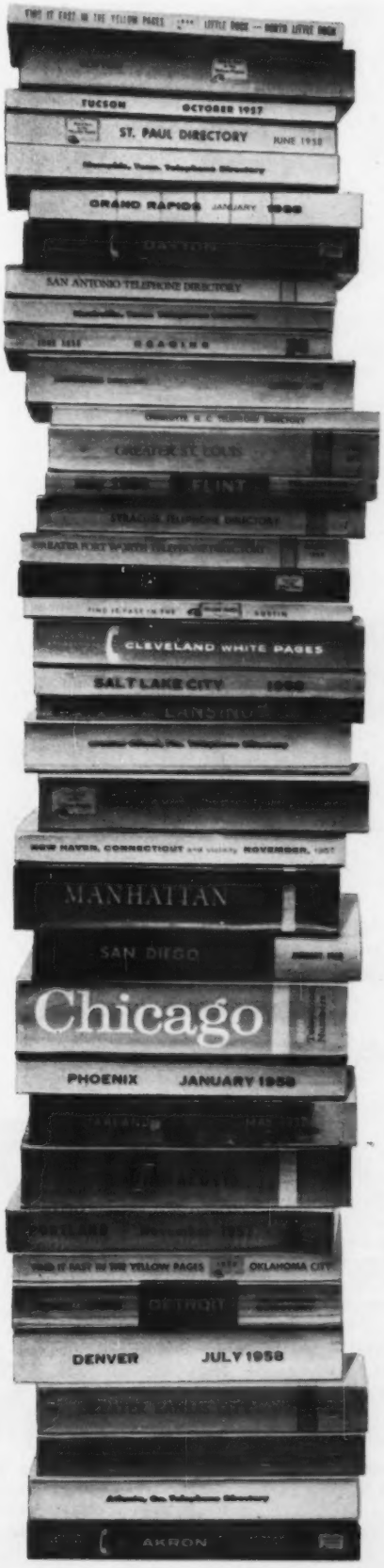
ALCOA RESEARCH

. . . development today for tomorrow's loads

ALCOA THEATRE
Fine Entertainment, Alternate Monday Evenings



1 in 35,000,000

How the telephone switching system sorts numbers in seconds

When you dial out of town, the telephone switching system performs an amazing feat. It sorts out the one other number in 35 million you want, and connects you to it in seconds. The other telephone may be thousands of miles away.

Bell Laboratories engineers endowed this great switching network with almost superhuman capabilities. As you dial, the machine listens, remembers, figures out the best route, makes connections, alerts, reports, even corrects itself. If it detects trouble on the way, it files a report, then chooses other circuits and goes on to complete your call. All you are aware of is the end product—the completed call.

Yet at Bell Telephone Laboratories, switching engineers see the present system as only a beginning. Ahead they see—and are developing—new systems vastly more flexible and capable than today's. Nowhere in telephone technology is the challenge greater. Nowhere are dreams coming true faster.

BELL TELEPHONE LABORATORIES

WORLD CENTER OF COMMUNICATIONS RESEARCH AND DEVELOPMENT

These Bell Telephone System directories list some of the 35,000,000 telephones now linked by the Direct Distance Dialing system developed at Bell Laboratories. In seconds, this unique machine sorts out and connects you with precisely the number you want.

Along today's modern highways easy-to-handle J-M Transite Ducts provide installation economies and years of service life, protecting traffic-signal, lighting, and other power-service circuits.

J-M Transite® Ducts install fast to last... give complete cable protection.

Because speed and economy set the pace in today's highway programs, more and more highway cables are going into Johns-Manville Transite Ducts.

For speed, Johns-Manville Transite Ducts are strong, light and long—easy to handle and install. Workmen set 10-foot lengths in place easily, join them up tight in seconds with snug-fitting J-M Plastic Couplings, and Transite's smooth bore is free of burrs and other obstructions that may interfere or cause damage during pulling of cables.

For economy, J-M asbestos-cement Transite Ducts go in to stay. Non-conductive Transite is not affected by electrolysis—resists the corrosive action of fills or high-salt soils in permanently damp locations. Millions of feet of installed Transite Ducts have proved that Transite withstands earth loads and soil stress . . . resists vibration and shock from highway traffic.

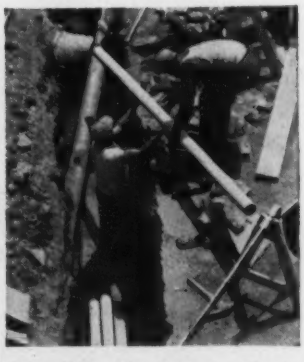
Let us send you free Transite Duct brochure EL-29A. Write Johns-Manville, Box 14, New York 16, N. Y. In Canada, Port Credit, Ontario.

JOHNS-MANVILLE JM PRODUCTS

JOHNS-MANVILLE Transite Ducts

Made of Asbestos-Cement

J-M Conduit for direct buried banks and exposed runs
J-M Korduct® for concrete banks



Johns-Manville Asbestos Transite Ducts can be laid directly in trench without concrete envelope or other mechanical protection.

SEATTLE CITY LIGHT'S 230/26-kv Duwamish Substation uses Southern States 34.5 kv-3000 amp Type WAG Switches with Amplitact Contacts.

The Man-sized Switch for Man-sized Jobs

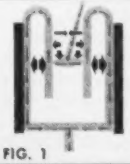


FIG. 1

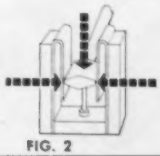


FIG. 2

AMPLITACT® CONTACTS ON WAG

High pressure Amplitact contacts provide maximum dependability under high current short-circuit conditions. The arrows in Fig. 1 show direction and relative magnitude of electromagnetic forces induced when switch is subjected to fault current.

The resultant electromagnetic forces, as shown in Fig. 2, greatly increase contact pressure and positively hold blade in the engaged position. For complete details, write for Bulletin 36AM on the Amplitact.

"Don't send a boy to do a man's job" is a saying especially applicable when choosing switchgear that must safely carry 3000-4000 amperes. Not only must it be capable of carrying such loads after years of service, but it may be called on to withstand fault currents up to 120,000 amperes without damage.

It's a man-sized job. Dirt, industrial waste, years of exposure to every type of contamination make the job even tougher. It takes a man-sized switch!

The Type WAG illustrated above is a good example. It's big and tough enough to carry its rated load continuously without excessive temperature rise. A built in safety factor more than compensates for the deteriorating effects of long, hard service. Amplitact® contacts provide high pressure for handling the heaviest faults.

The WAG is finding wider and wider acceptance in all ratings. It's now in service in virtually every state in the union.

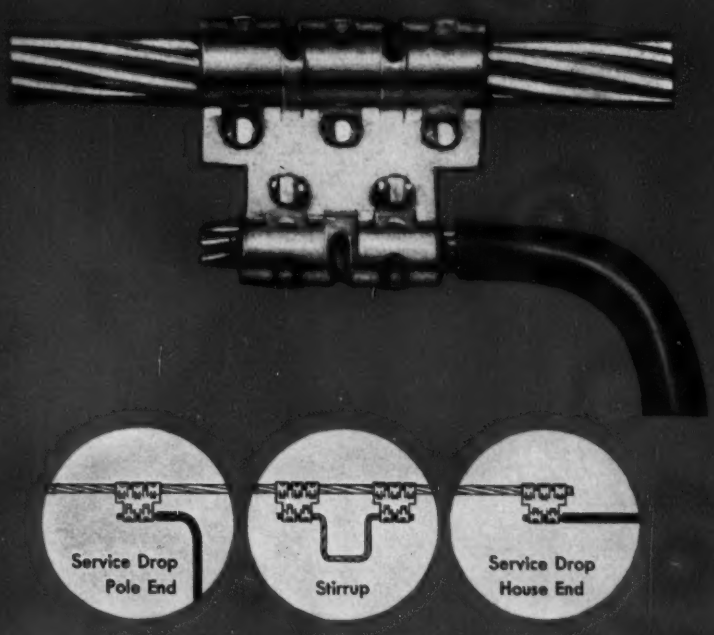
Get complete details from your Southern States representatives or write direct for our latest bulletin.

LIVE BETTER ELECTRICALLY

SOUTHERN STATES
EQUIPMENT CORP.
HAMPTON, GEORGIA

IN CANADA: Dominion Cutout Co., Ltd., Toronto

The TAP that TOPS them all...



THE MULTI-PURPOSE AMP UTILI-TAP®
for aluminum and/or copper conductors

Tired of all the expensive clutter in your stock rooms—a special tool for this, a special piece of hardware for that? Now you can clear out a lot of your inventory clutter with all new A-MP UTILI-TAP®.

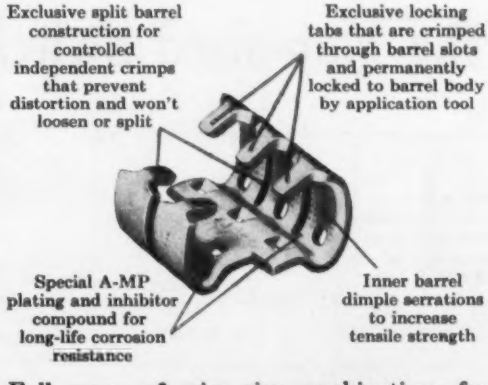
Here is a product that can be used on diverse tapping installations—like no other product on the market. It's permanent, it's sure and it will do many, many jobs.

Your stock can be simplified and easily maintained. Your linesmen can now go up the pole without pockets filled with miscellaneous parts or belts loaded with special tools. Simplify with the A-MP UTILI-TAP®.

Light-weight matched tooling available in mechanical or hydraulic types.

The only tap on the market that converts from an easily attached open barrel construction to a permanent, closed barrel attachment.

Look at these unbeatable features:


Exclusive split barrel construction for controlled independent crimps that prevent distortion and won't loosen or split
Exclusive locking tabs that are crimped through barrel slots and permanently locked to barrel body by application tool
Special A-MP plating and inhibitor compound for long-life corrosion resistance
Inner barrel dimple serrations to increase tensile strength

Full range of wire size combinations for aluminum, copper or ACSR conductors.

Send today for more information to solve your tap inventory and reliability problems simultaneously.

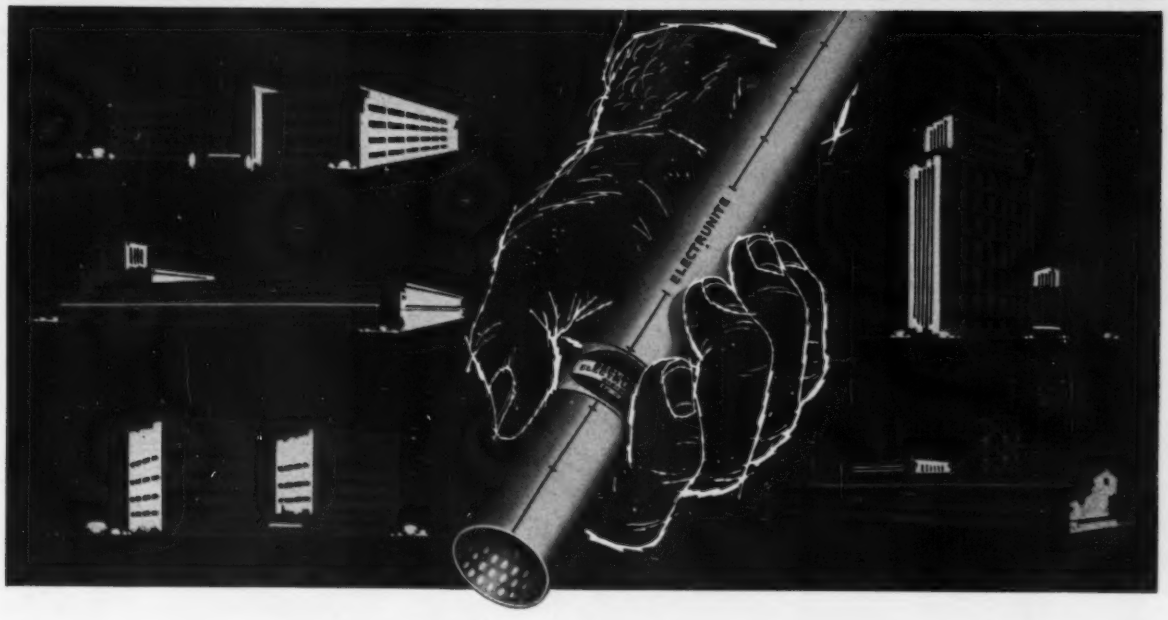
American Pamcor, Inc.

api AMERICAN PAMCOR INC.

GENERAL OFFICES: 181 HILLCREST AVE., HAVERTOWN, PA.

Exclusive Distributor For AMP Products To The Utility Industry

THE BEST COSTS LESS INSTALLED



meet tomorrow's power demands today with Republic ELECTRUNITE ELECTRICAL METALLIC TUBING

Building better communities—better schools, apartments; office buildings, shopping centers, commercial and industrial plants—demands ample-sized conduit that will meet tomorrow's load-building demands today. Republic ELECTRUNITE® E.M.T. offers economies that "protect now . . . and provide for the future".

Power producing utilities can meet the challenge and opportunity of future raceway capacity. By using and suggesting to their customers that Republic ELECTRUNITE E.M.T. offers economies, they can recommend adequate size raceways be installed, giving all the advantages of a pull-in, pull-out, grounded system.

The economy of installation, too, is a factor, since ELECTRUNITE E.M.T. is "INCH-MARKED"® in feet and inches on all popular sizes for quick, easy, accurate measuring. Full length "GUIDE-LINE" and Republic Bending Tool helps to keep bends in the correct plane—avoiding "wows", wasted time and material.

Another installation advantage is the exclusive "INSIDE-KNURLING" providing a ball-bearing like surface that makes wire pulling as much as 30% easier—provides electrical raceway flexibility to meet future load-building demands at no extra installation cost.

ELECTRUNITE E.M.T. is produced to A.S.A. Specification C80.3 and Federal Specification WW-T-806, latest revisions, and carries the Underwriters' Seal of Inspection. Complete wire protection in accordance with the National Electrical Code.

That's why utilities can safely recommend ELECTRUNITE E.M.T. to their customers and also consider Republic ELECTRUNITE E.M.T. for their own plant installation and expansion programs. The economies afforded using ELECTRUNITE E.M.T. may be applied to the purchase of additional load-building equipment and conveniences.

REPUBLIC STEEL
STEEL AND TUBES DIVISION

REPUBLIC STEEL

Cleveland 8, Ohio

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION
DEPT. C-5668-R
213 EAST 131st STREET • CLEVELAND 8, OHIO

I want to learn more about Republic ELECTRUNITE E.M.T. Please send additional information.

Name_____ Title_____

Firm_____

Address_____

City_____ Zone____ State_____

News about

B.F.Goodrich Chemical *raw materials*

Two-inch and six-inch pipe and fittings, as well as pipe supports at Florida Keys Electric Cooperative, Marathon, Florida, are made from Geon rigid vinyl. B.F.Goodrich Chemical Company supplies the rigid vinyl material only.

Pipe of Geon cures corrosion caused by ground currents

SEA water is used in the raw water system of this diesel generating plant, and electrolytic corrosion of the metal piping in the raw water system created quite a problem. Then pipe made from Geon rigid vinyl was installed and, after two years of operation, there is no corrosion problem in the piping handling the sea water.

The addition of a larger diesel unit to the plant now calls for six-inch pipe made from Geon rigid vinyl to handle the salt water used in cooling the diesels and lubricating oils, and for piping Bunker C fuel oil from the oil storage tanks to the plant. Even the pipe supports are made from Geon rigid vinyl.

Pipe of Geon is the logical choice wherever corrosion causes problems. And there are installation savings, too. Pipe of Geon is lightweight and easy to handle. Contractors like it. Can be readily joined by solvent welding or standard threaded fittings.

How can you benefit from pipe made of Geon rigid vinyl? Get information by writing Dept. LR-11, B.F. Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio.

Cable address: Goodchemco.
In Canada: Kitchener, Ontario.

B. F. Goodrich Chemical Company
a division of The B.F.Goodrich Company

SEE US AT BOOTH NO. 509
8TH NATIONAL
PLASTICS EXPOSITION
NOV. 17-21
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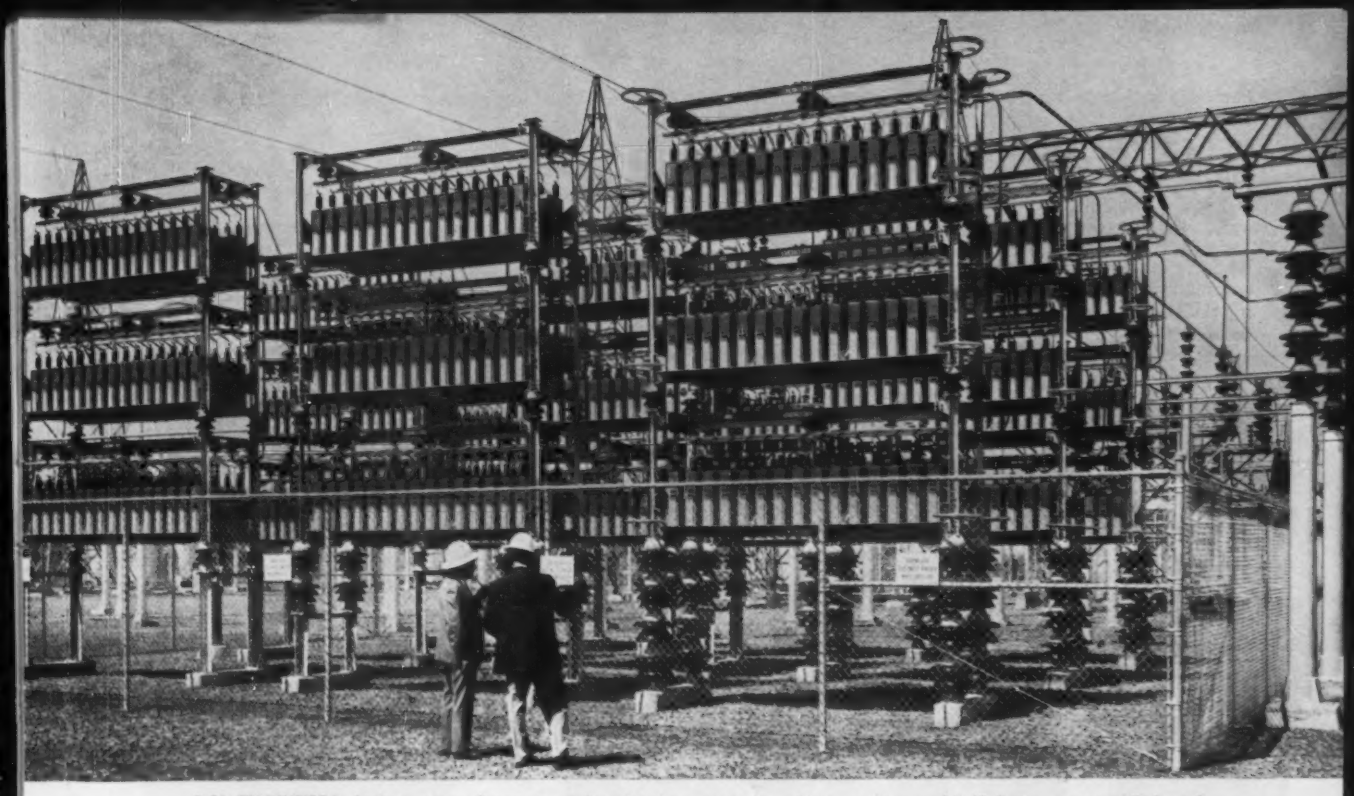
GEON polyvinyl materials • HYCAR American rubber and latex
GOOD-RITE chemicals and plasticizers • HARMON colors



L-M ENGINEERS design many large capacitor banks, such as this 40,500 kvar, 230 kv switched bank, said to be the highest voltage shunt capacitor bank in the country. It is made up of L-M factory-assembled and wired blocks of 50 kvar Elemex capacitors, such as the one shown below.

L-M Designs Capacitor Installations From 240 Volts To This 230 kv Bank

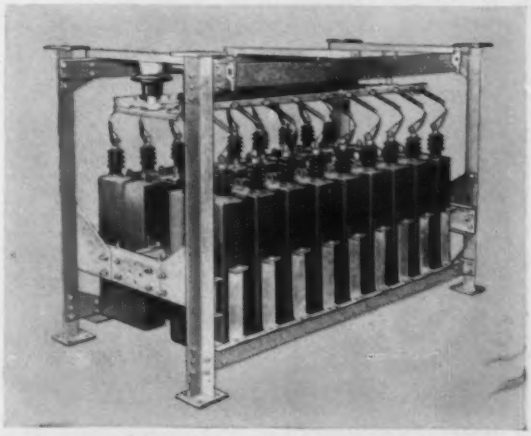
The bank shown above (location on request) consists of twenty-seven 1500-kvar split-bus capacitor blocks. Each block contains thirty 50-kvar 7200-volt single-bushing Elemex capacitors; each individually fused, in two series groups.

Each phase contains eighteen series groups in nine blocks for a voltage of 129,600 per phase to neutral.

Since the neutral is solidly grounded, graded base insulation is used—196 kv porcelain under the incoming line stack; 69 kv under the middle stack; and 15 kv under the third stack. Notice also the corona rings on all blocks of the incoming line stacks at the right.

Let L-M Engineer YOUR Banks

Call on the L-M Field Engineer for anything from a 3 kvar secondary capacitor to the largest bank. He can provide literature, and tell you how to get L-M application engineering service. Or write Line Material Industries, Milwaukee 1, Wisconsin.



TYPICAL L-M BLOCK OF Elemex capacitors. Block is assembled and wired at the factory, ready to install. L-M was the first with 50 kvar capacitors and a leader in the engineering of pre-wired blocks and pole-type racks, which can be supplied with or without oil switches mounted on the rack.

364

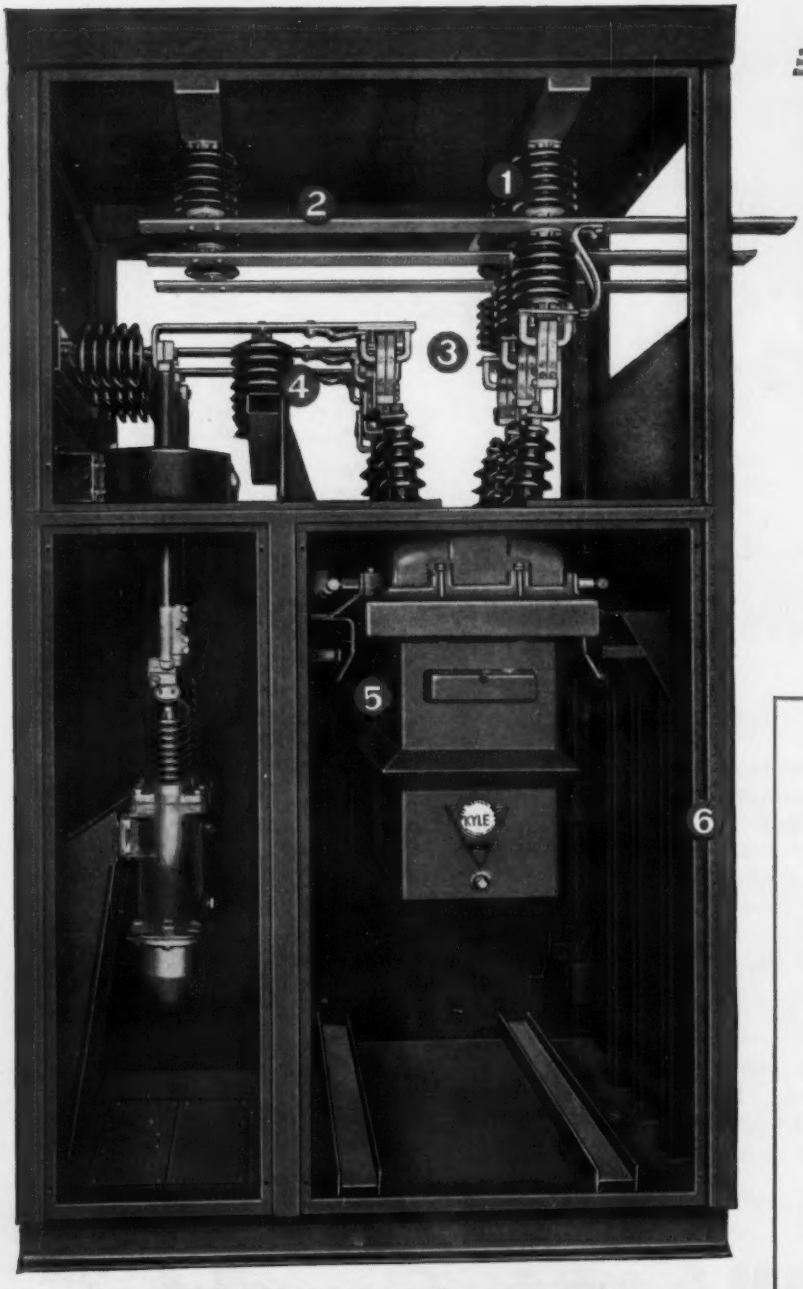
LINE MATERIAL Industries *Elemex*® **Capacitors**

McGRAW-EDISON COMPANY

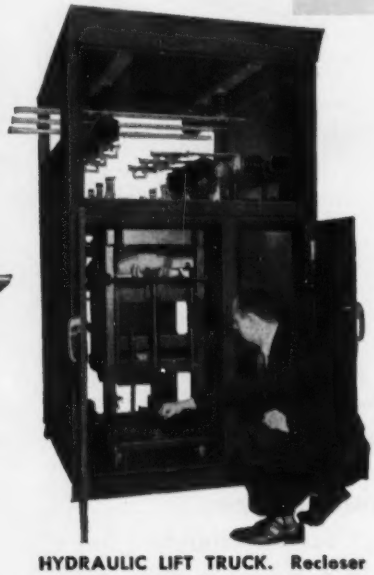
DISTRIBUTION TRANSFORMERS • KYLE RECLOSERS AND OIL SWITCHES • FUSE CUTOUTS AND FUSE LINKS • LIGHTNING ARRESTERS
POWER SWITCHING EQUIPMENT • PACKAGED SUBSTATIONS • CAPACITORS • REGULATORS • OUTDOOR LIGHTING
LINE CONSTRUCTION MATERIALS • PORCELAIN INSULATORS • FIBRE PIPE AND CONDUIT

McGRAW EDISON

1. Porcelain bushings—which, with air insulation, give high impulse and corona levels, and greater permanent creepage strength than phenolic insulation.
2. High location of main bus permits normal operation in flood areas. Units can operate in over 2 feet of water without damage or service interruption.
3. Recloser primary and secondary connections are automatically made as recloser is raised into operating position. Bushings on recloser have special flexible self-aligning disconnects.
4. One of a number of troughs provided for low-voltage wiring.
5. Type W Recloser. Type R may also be used where loads are smaller, and changed to Type W when situation necessitates.
6. Compact—takes from 10 to 25% less ground area (and a smaller pad), and 25 to 35% less volume than comparable metal-clad equipment.



REAR VIEW of feeder unit with all panels removed.



HYDRAULIC LIFT TRUCK. Recloser is easily removed, or inserted and locked into operating position. Mechanical interlocks make it impossible to insert recloser into primary contacts unless recloser is in OPEN position.

Let's Clear Up "Clearing Time"

The published time-current characteristics for Kyle oil circuit reclosers include the *total* time, from instant of fault initiation to the completion of arc extinction. This includes the complete fault sensing period, tripping time, and sufficient contact travel time for complete interruption.

Since the fault sensing and timing means is incorporated within the Kyle recloser, this recloser is independent of external devices, which themselves may add appreciable time to the operating time claimed for other devices.

Thus the 2 or 2½ cycles in which Kyle reclosers clear faults is appreciably less time than that required by devices usually incorporated in metal-clad equipment. Therefore, Kyle switchgear gives much better protection to conductors, and much better insurance of service continuity.

THE NEW KYLE-KLAD SWITCHGEAR is designed so that the basic unit is simple, functional, and extremely economical, offering substantial savings over traditional metal-clad. But the design also makes possible a wide choice of variations, optional arrangements, and accessories to suit almost any requirements.

Kyle-Klad Metal-Enclosed Reclosers Offer Many Outstanding Features

Faster Clearing...Better Coordination...Lower Cost ...Porcelain-and-Air Major Insulation...Space Savings ...Provision for Future System Planning

FRANK McSTAY demonstrates accessibility of the meter compartment. The attractive low-line appearance of the Kyle enclosure makes it very desirable for urban areas. The unit is completely weatherized with phosphatized treatment, primer, and two coats of alkyd resin paint. Ventilators allow circulation of filtered air. Heaters prevent condensation of moisture.

by **FRANK W. McSTAY**, Product Manager
Kyle Switchgear, Line Material Industries

All of the well-known advantages of the Kyle Type W or Type R reclosers, plus simple, functional design, are now available in the new L-M Kyle-Klad metal-enclosed switchgear.

Cost As Low As $4,540

The units are simple and compact. They are highly efficient, and provide many advantages, at a substantially lower cost than that of the traditional metal-clad units. For example, the basic 15 kv 110 BIL feeder unit costs only $4,540.

Fastest Clearing Time

The reclosers themselves provide the fastest clearing, from fault initiation to arc extinction, of any device on the market. This high-speed clearing gives better protection to conductors against burndown and annealing, and thus assures better service continuity. Timing of the recloser is accomplished by self-contained time delay mechanisms which have indexed settings for specific time current characteristics. Kyle's usual wide choice of time current characteristics is available.

The units are quite flexible in many respects. There is a wide choice of optional equipment. Future expansion is easily handled, by either changing reclosers or adding additional feeder units. Space is provided in the auxiliary compartment for lightning protection. Many other features and options are available.

The units are compact, and installation is simple. They require less pad area, and therefore, less concrete. Fewer manhours are required for installation, offering additional savings. Thus Kyle-Klad equipment offers savings you cannot afford to ignore.

Get This Bulletin and Details From The L-M Field Engineer

Or write Mr. McStay at Kyle Products Division, Line Material Industries, Milwaukee 1, Wisconsin. In Canada: Canadian Line Materials, Ltd., Toronto 13, Ontario.

LINE MATERIAL Industries

McGRAW-EDISON COMPANY

Kyle® Switchgear

McGRAW EDISON

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DON'T GET ME WRONG...I STILL DON'T LIKE STORMS

"But they don't seem to hit us so hard any more. Not since polyethylene coated wire came along."

The lineman's boss also gives polyethylene credit for reducing outages during storms. This tough plastic forms a continuous shield that resists moisture, weathering and aging. It protects the conductor from contact with wind-whipped branches and wires, prevents short circuiting by chance electrical contacts.

Protection is long-lasting. Early installations have shown no deterioration after 11 years exposure to all sorts of weather. And accelerated aging tests point to an expected life as great as 40 years.

In winter, polyethylene coated wire stands up better than other types because it is lighter, has a smaller diameter. It offers less resistance to wind and ice . . . supports a greater weight of ice without breaking.

Easier Installation, too . . .

Polyethylene is easy to handle because it's clean . . . self-lubricating . . . readily stripped. Yet it adheres well, doesn't ruffle when pulled.

Here are some of the applications where polyethylene is giving outstanding service:

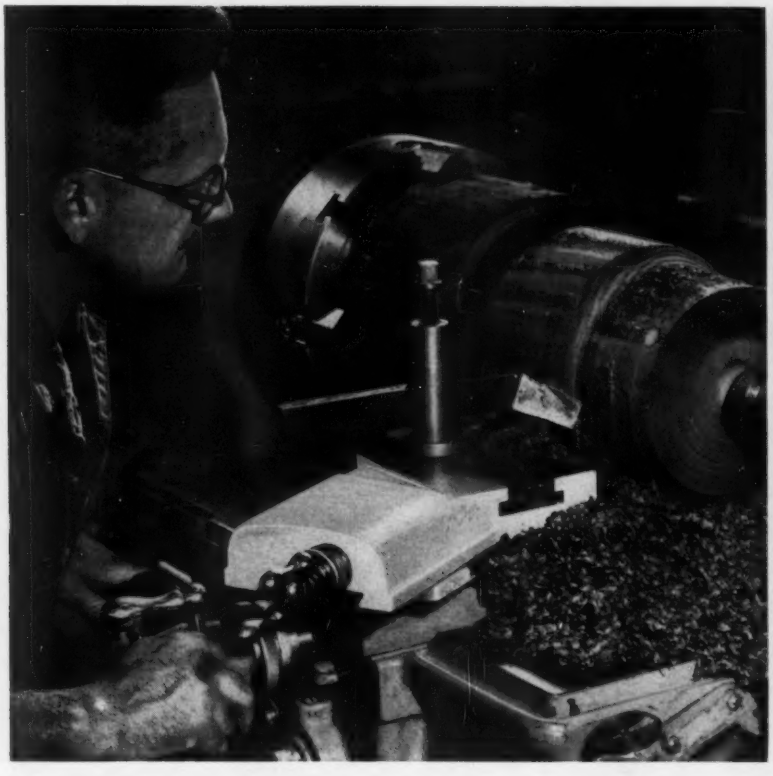
- Line wire covering
- Communication cable insulation and sheaths
- Power cable dielectric
- Tree wire covering
- GTO (Neon Sign) Cable
- WD-1 Infantry Field Wire
- Control cable insulation and jacket
- Corrosion protection for metal sheaths
- TV Lead Wire

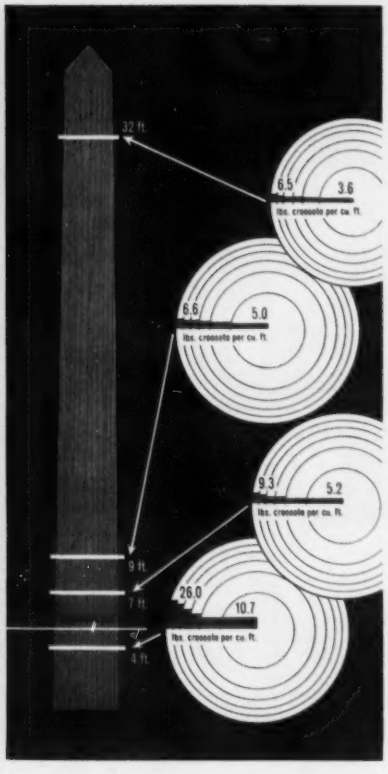
But all polyethylenes aren't the same. Ask your supplier about the superior weather and stress-crack resistance of coatings made with PETROTHENE® polyethylene resins. You pay no more for PETROTHENE quality.

U.S.I. INDUSTRIAL CHEMICALS CO.
Division of National Distillers and Chemical Corp.
99 Park Ave., New York 16, N. Y.
Branches in principal cities

Makers of PETROTHENE® Polyethylene Resins

PREFORMED ARMOR-GRIP SUSPENSION provides a . . .
Pretty Soft Life for a Conductor
. . . cradled in durable neoprene
No vibration fatigue here. The Preformed Armor-Grip Suspension (AGS) eliminates failure by eliminating stress concentration.
The conductor is cushioned in a split neoprene core, held securely by Preformed rods that never lose their tight grip, and supported in an aluminum housing. Conductor is protected and longitudinal stresses are distributed through the entire length of the rods—not at one point.
Like other Preformed line accessories, the AGS obsoletes bolted hardware. It's easier to apply (no tools needed), costs less, does a better job. You get mechanical strength and electrical protection, and—because of the smooth contour and large diameter of the rod ends—corona emission and radio influence are minimized.
Want to know more about the Preformed Armor-Grip Suspension—or see the application demonstrated? Write PREFORMED LINE PRODUCTS COMPANY, 5349 St. Clair Avenue, Cleveland 3, Ohio. Cable Address: Preformed-Cleveland . . . in 10 years the leading manufacturer of armor rods, dead ends, Guy-Grip dead-ends and other line accessories.
You can look up to Preformed T.M.
Made in accordance with or for use under one or more of the following U. S. Patents: 2,722,393; 2,875,019; 2,887,521; 2,609,653; 2,691,865; other patents pending.





We pull poles to stretch service life

Scientists at United States Steel's Applied Research Laboratory conduct continuing studies to determine how and why pressure creosoting gives longer life to wood. In one experiment, a power-line pole that had been in use for 23 years was pulled from service and taken to the laboratory for study. Sections from various parts of the pole were cut out and reduced to minute shavings. Care was taken to keep the shavings from each layer of each section separate. Then, by using solvents and special extraction methods, the creosote from each batch of shavings was recovered. Analysis of the shavings from each section revealed how the creosote had behaved during service.

Results:

1. The original treatment averaged 8.6 pounds of creosote per cubic foot of wood. After 23 years, the average over-all retention was 6.6 pounds per cubic foot—more than enough creosote to ward off the heaviest attacks of termites or rot-producing fungi.

2. The creosote was gradually *redistributed* throughout the pole (see diagram). The creosote had actually formed an "armor belt" extending from about three feet below the ground line to 2½ feet above the ground line. In this important section, creosote concentrations were 3 to 20 pounds *more* than the average—and they were heaviest near the outside of the pole where protection was most needed.

3. The test indicated that a pressure-creosoted pole like this one might last for 50 to 60 years under similar conditions.

For more information on the advantages and economies of pressure treatment with USS Creosote, write to United States Steel, 525 William Penn Place, Pittsburgh 30, Pa., or call your nearest USS Chemical Sales Office in Pittsburgh, New York, Chicago, Salt Lake City or Fairfield, Alabama. *USS is a registered trademark*

USS Creosote

DOSSERT UNDERGROUND CONNECTORS...

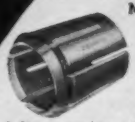
the versatile line

featuring:

- Fully molded, no factory taped joints.
- Insulated with MYPAR* rubber for higher quality and longer life, or MYPRENE* rubber for higher temperature resistance, and greater resistance to acids and oils.
- Made of high conductivity copper, insuring cool operation.
- Interchangeable with all standard underground connectors and their component parts.
- Made to fit standard compression tools.

MICON* type MC

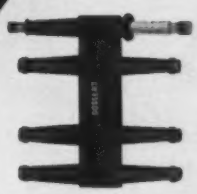
MICON COMPONENTS



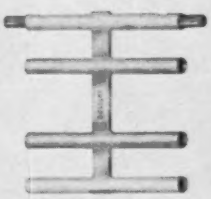
Tapered Compression Sleeve type C

Cable Receptacle type MA

Insulating Sleeve for MICON Outlet type MIS



Insulated Crab Connector type CBR



Uninsulated Crab Connector type CBN

MICON Stud Connector type MCBS

Limiter Link Assembly type LLA

Limiter Link Assembly type NLRA

Terminal Lug type DPL

Comp. Coupler type DPC

Comp. Tee Coupler type CRT

*U.S. Reg. Trade Mark

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Uptegraff

UPTEGRAFF Pressure Testing
is only one of a series of important tests which insure the high quality of Uptegraff power transformers.

POWER TRANSFORMERS

Advanced Testing Techniques Pay Off in Performance and Economy

Typical of the many quality control tests which Uptegraff applies in the production of transformers is pressure testing, illustrated on the left.

The transformer is completely filled with oil (or Askarel), so that the oil extends up into a container temporarily mounted on top of the transformer. Pressure, applied by a nitrogen bottle in the amount of three or four pounds, is sustained for at least four hours. This is a final pressure test to determine the integrity of all the seals, gaskets, glands, threaded fittings, and welds.

When transformer oil is removed to bring the liquid level down to the correct height, the nitrogen replaces the oil. Consequently, when the transformer is shipped, the space above the oil is filled with dry nitrogen. In this way the transformer is certain to be supplied free of any moisture or atmospheric contaminants. This is one of Uptegraff's advanced features which inevitably pays off in top performance and economy.

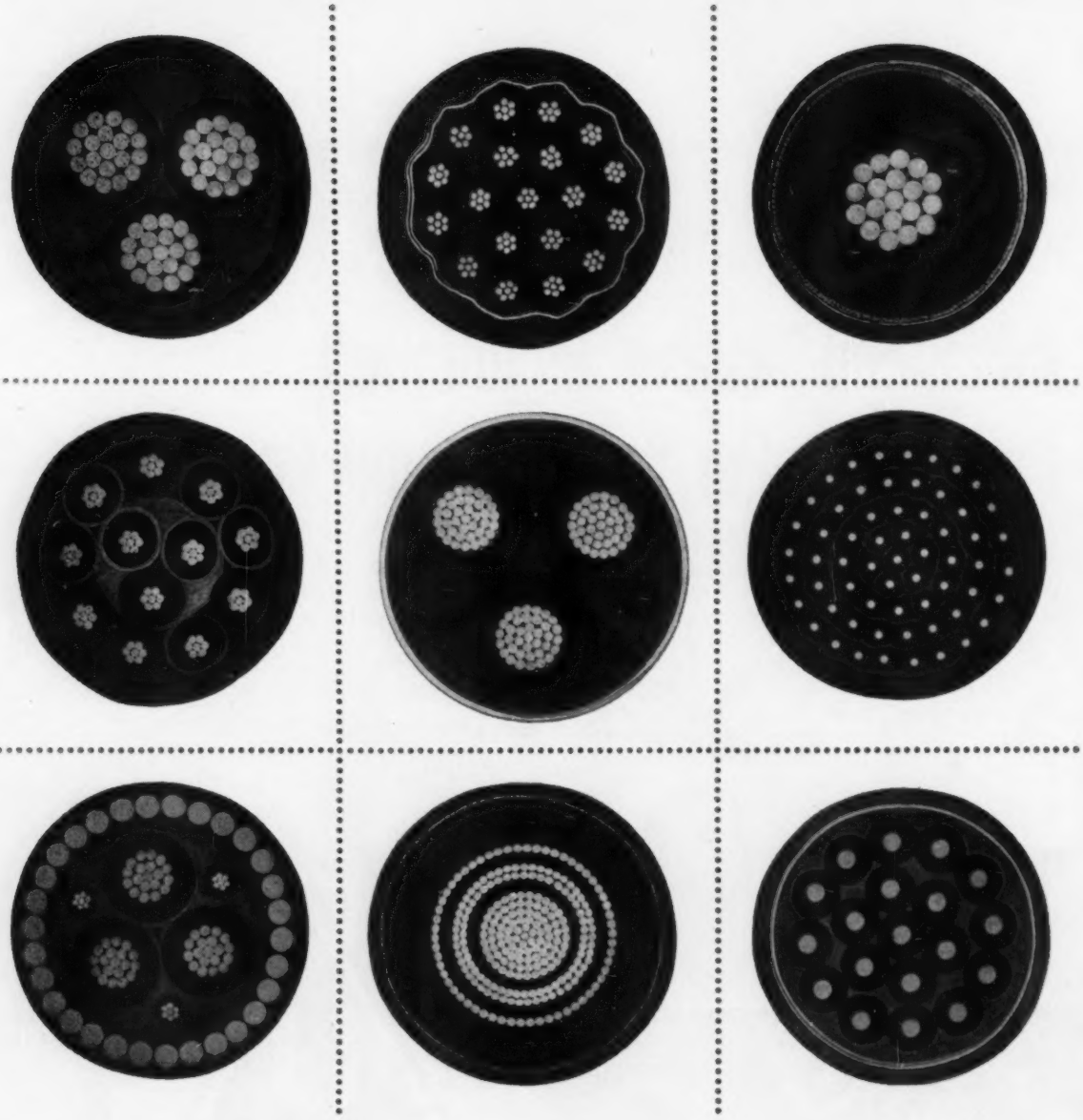
Write for Bulletin 133 . . . which gives complete Engineering Data on Uptegraff power transformers ranging up to 10,000 kva, liquid-filled (oil or Askarel) for indoor or outdoor service. Uptegraff also manufactures Load Center, Distribution, Network, Dry Type Lighting, Instrument and Specialty Transformers.

UPTEGRAFF Impulse Testing

Uptegraff goes to great length to assure the electrical integrity of transformers. One example of Uptegraff's thoroughness in testing the electrical quality is seen on the immediate left. Here a 2500 kva transformer on the test floor is being surge tested to determine its lightning withstand characteristics—so necessary to high level operation on today's modern power distribution systems.

R. E. UPTEGRAFF MANUFACTURING COMPANY

SCOTTDALE, PENNSYLVANIA



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—take advantage of the unique properties of Kerite insulation. Let a Kerite engineer explain why no other cable can equal Kerite's performance in actual service, dependability, and long-time economy. Kerite cables are designed for a variety of applications and operating conditions, and are available in forms and finishes best adapted to your requirements. Be sure. Specify Kerite.

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KERITE CABLE

it's the **KERITE** *that makes the difference*

Editorial Comment

OCTOBER 13, 1958

Research Clears The Way for Future Transmission Systems

Any lingering doubts that may remain about the surging upward trend of transmission voltages in the extra high voltage range have been thoroughly put to rest with Ontario Hydro's announcement (Sept. 15, p 42) of tests at up to 600 kv beginning next April.

Taken against the background of the high-altitude 345-kv tests in progress at Leadville by Public Service Co of Colorado and several cooperating manufacturers as well as the 600- to 750-kv experimental system planned by General Electric and others, it is clear that the way is being opened for new transmission voltage levels in the neighborhood of 460 kv.

Need for such a voltage level in the next decade is foreseeable in the special report on transmission modernization presented elsewhere in this issue (p 67). It is evident that sheer economics of transmitting large blocks of power and the mounting right-of-way shortage are both forcing utilities in this country to 345 and 460 kv. This is particularly true in areas where load densities exceeding 10,000 kw per square mile are foreseeable in the next five to ten years.

The electrical manufacturing industry is already giving serious consideration to the development and design of necessary line and terminal equipment. New research projects that have been launched this year in the U.S. and Canada give further assurance that utilities will have the necessary technical know-how and equipment to build these new high-voltage systems when the time comes.

The Ellis Proposals: Politics and Power

The Management Newsletter of our Sept 29 issue was devoted to publishing substantially all of the text of a recent speech by National Rural Electric Cooperative Association General Manager Clyde T. Ellis, in which he outlines his legislative proposals for the coming year.

In analyzing these proposals, one aspect of them comes through crystal clear: their real goal is political rather than electric power. In fact, it is no exaggeration to say that they are designed to attain political ends that neither major party in the United States recognizes as legitimate.

The Rural Electrification Administration and the electric co-ops which have come into existence as a result of it have found a place in our industry. This position, which the co-ops now enjoy, may be the one most damaged by these proposals, because they go far beyond the original intent of the REA Act—to bring electric service to rural folks—and strike at one of our basic concepts: that the cause of individual freedom is served best when the centers of political and economic power are kept separated. The Ellis proposals would serve not to save REA from what he calls a "Master Plan" to destroy it, but rather to chip away at our freedom by concentrating too much power—political and electrical (economic)—in the hands of government.

Now we do not believe that the rural Americans, whom Ellis purports to represent, really seek to destroy our freedom. What they do want, and are entitled to, is something very simple: dependable electric service at reasonable rates, with none of the political flimflam.

Furthermore, we think the responsible elements in the electrical industry are capable of working together to see that the real needs are met. At the same time all three segments should try to gain a perspective that makes each aware of the realities of the situation and the ends to be served.

SEE Multiple Housing Study Shows

• Though not specifically a rebuttal of the 'Zinder report,' it rejects the fuel-costs-only approach to utility service for multiple housing. Claims other factors must be considered

A special committee of the Southeastern Electric Exchange presented last Thursday to government officials its economic study on the usage of various utilities in multiple housing projects.

Meeting in Washington, the group, headed by Georgia Power Co's Sales Vice President C. M. Wallace, made available the findings of its inch-thick, charted, and diagrammed report impressively entitled "Economic Study of Electric, Gas, and Oil Usage for Capehart and other Public Housing Projects." Other members of the Wallace team to help make the pitch were: C. W. Cheatham, Alabama Power Co, and R. W. Wages, Georgia Power Co.

The report, which is characterized by a carefully worded, slow, exacting approach, begins: "A comparison of not only the estimated annual costs of electric and/or fuel usage does not, by any practical standards of reasonable consideration, form a justifiable basis for final decisions as to what utility service or utility services should be specified for military housing.

"Decisions based solely on the estimated costs of electric and/or fuel usages do not take into consideration all of the practical and pertinent elements of costs actually involved, and could lead to the selection of a utility service or combination of utility services that was not, in fact, most economical to use."

Not a Point-by-Point Rebuttal

SEE had previously emphasized that the report (before it was issued) was not to be a point-by-point rebuttal of the gas industry's "Zinder report" (EW, Mar. 24, p 66). And from all appearances, it is not. Rather, it questions implicitly the validity of the approach the Zinder report made to the problem of utility service to multiple housing. Here are some of the other important factors which the SEE report says must be considered.

• How will the total annual costs be influenced by future increases or decreases in electric, gas, and/or oil rates? (This was an item of considerable importance in the minds of Air Force officials in their decision involving the Little Rock, Ark., AF Base (EW, Aug. 26, p 44).

• How will total annual costs be influenced by a need to provide further specialized maintenance forces, such, as for example, separate personnel for maintenance and operation of the electric, gas, and/or oil systems and household equipment and appliances installed?

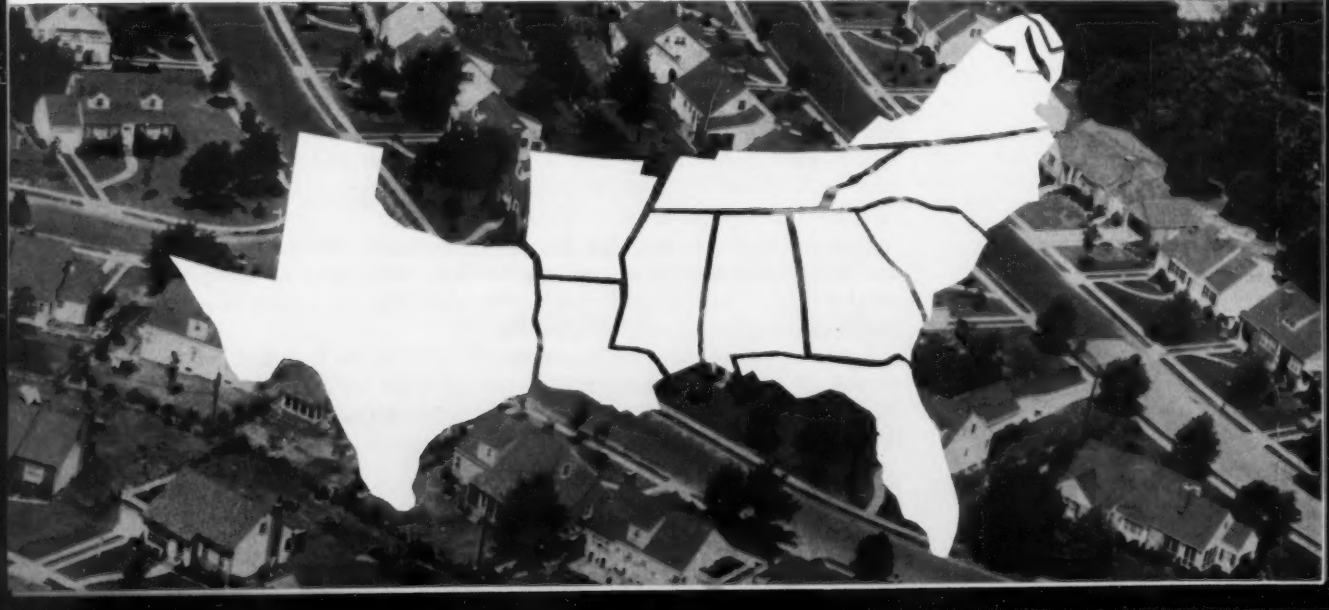
• How do intangibles, such as health, safety, cleanliness, convenience, and other considerations influence the present and future desirability of the services and facilities provided, as well as the present and future dollar value of the housing project?

• How will the capital investment be influenced by the occupants' present demands for accepted living standards and possible future demands for even higher standards of living. The occupants' continued satisfaction with the housing facilities and services of prime importance. (Apparently the Armed Forces are realizing that housing is an important morale factor that shows up around reenlistment time.)

It is considerations as these that SEE feels must be taken into account in order to get a realistic idea of the costs involved.

To drive home this basic point, the Southeastern Electric Exchange Sales Section made various cost

WILL IT BE ELECTRIC OR GAS for government housing projects like this in the Southeastern Electric Exchange area?



Electric Best

estimates which allow for some of these factors for a group of 1,000 military housing units when added at five different armed forces bases whose load and other existing conditions were known. Breakdown of the five installations are:

- One project would use electricity for all household needs, including year-round air conditioning.
- One would use gas predominantly, with electricity only for lights, refrigeration and miscellaneous small appliances. It would use auxiliary motors for heating and air conditioning equipment.
- One project would use gas for heating, and electricity for all other household needs.
- Two of the projects would use oil for heating, and electricity for all other household needs.

SEE then proceeded to estimate only the fuel costs. Then it factored in the other costs to arrive at a total annual cost. A summary of these two sets of costs, as they would probably appear, are given in Tables I and II, respectively.

To arrive at the total-cost figures in Table II, the committee added capital costs and applicable annual charges such as taxes, interest, amortization, maintenance, and other operating expenses.

Capital Costs Must Be Included

Because budget expenditures are influenced by both annual charges and first cost (capital) expenditures, the committee felt that capital costs cannot logically be excluded from consideration in deciding on the type utility service.

However, the committee excluded the effects of trends toward increasingly higher rates for gas and other fuels, which if they had been included, would make the use of these fuels even less favorable.

The committee, in its report, also made one other point: It is necessary to examine in detail the merits of each case, considering the overall economics in a detailed analysis. Their final conclusion: ". . . based on total costs, all-electric service would provide the best over-all economies in most cases. Except in rare instances, even though some other combination of utility services might produce a total lower cost of ownership and utilization, the outstanding advantages and modern conveniences provided by all-electric service should more than compensate for the differential. . . .

"All-electric, not other combinations of utility services, will be indicated, almost without exception, when decisions are based on complete and careful analysis of each individual case considered."

TABLE I — Summary of Annual Energy and Fuel Costs, Only, For Utility Services to 1,000 Capehart Homes When Added to a Military Base

Degree-Day Area	All-Electric Homes		Predominant Gas Homes	Electric-Gas Homes	Electric-Oil Homes
	Heat Pumps	Resistance			
4500	$222,082	$262,334	$270,057	$231,402	$206,999
3500 (1)	213,622	244,968	142,327	131,081	206,351
2500	151,222	175,835	100,798	101,172	181,563
1500 (2)	135,137	150,961	361,217	219,132	153,615
500	171,980	175,440	272,193	164,946	159,045

NOTES—1. Especially low negotiated gas rate averaging 4.84¢/therm. Normally available gas in this area at approximately 9¢/therm.

2. Butane-Propane-Air System; gas distributed by gas utility at 19¢/therm. Nearest natural gas (same utility company) approximately 120 miles away, with a cost of approximately 9.5¢/therm for this type of service.

ACCORDING TO THE SEE REPORT, conclusions based on the total annual costs set forth in Table II (below) would probably look something like this:

1. Three of the housing projects analyzed would use electric service for all household needs, including year-round air conditioning. One of these three projects would find it more economical to use electric resistance heating and conventional air conditioning. The other two would use heat pumps.

2. Two of the housing projects would use a combination of gas and electric service, in which gas would be used solely for house heating purposes.

Note—For one of the two projects included in (2) above, the combination of electric and gas service has only a nominal advantage in evaluated total costs over all-electric service.

TABLE II — Summary of Annual Total Costs For Utility Services to 1,000 Capehart Homes When Added to a Military Base

Degree-Day Area	All-Electric Homes		Predominant Gas Homes	Electric-Gas Homes	Electric-Oil Homes
	Heat Pumps	Resistance			
4500	$472,692	$504,138	$591,506	$525,149	$488,744
3500 (1)	464,232	485,790	463,776	424,828	488,096
2500	401,832	415,223	422,247	394,919	463,308
1500 (2)	385,747	389,998	682,666	511,895	434,358
500	422,590	413,091	593,642	458,693	440,790

NOTES—1. Especially low negotiated gas rate averaging 4.84¢/therm. Normally available gas in this area at approximately 9¢/therm.

2. Butane-Propane-Air System; gas distributed by gas utility at 19¢/therm. Nearest natural gas (same utility company) approximately 120 miles away, with a cost of approximately 9.5¢/therm for this type of service.

U. S. Power Picture

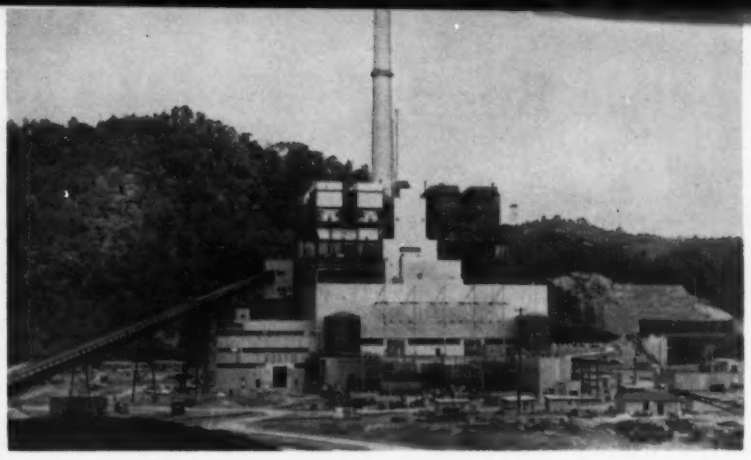
- More Dixon-Yates debate
- Sulphur control try dies

The legal process of fixing government liability for cancelling the controversial Dixon-Yates power contract keeps moving slowly along. The Dixon-Yates group in 1956 filed claims for about $3.5-million damages as a result of the cancellation. It looks now as if the U. S. Court of Claims may hear final arguments in the case sometime in March or April.

Latest papers filed come from a court commissioner, setting out the facts established in the trial, but making no conclusion on whether the government is liable for any damages. The report does say that if the court declares the government liable, maximum damages should total about $1.8 million: $430,000 in legal fees; the rest to cover other expenses incurred by the power companies such as contract obligations to construction and engineering firms.

• Louisville's city-county air pollution control board decided recently not to impose regulations limiting the sulphur content of fuels. The board found that it would cost industry $5,784,000 a year to burn low-sulphur coal. Estimated increases in consumers electric rates would be as high as 13.85%.

In Los Angeles a public hearing has been set for Oct 22 on a proposal to limit sulphur content to 50 grains per cu ft of gas and ½% of liquid fuel by weight.



AEP Co Passes 5-Million Kw Mark

With the addition of the 225,000-kw unit one at Clinch River Plant at Carbo, Va., American Electric Power Co became the first electric power company in the world to exceed 5-million kw of generating capacity.

The Clinch River unit raised total capacity of the the AEP system to 5,113,000 kw.

A second generating unit of the same capacity is slated for completion in November. The plant is owned and operated by Appalachian Electric Power Co, one of the six operating companies in the AEP system.

Atomic Progress

- Objections to dual-purpose reactor appear to be in vain
- First regional interstate compact approved in the South

Any private-utility hopes that the Eisenhower Administration would buck congressional Democrats and refuse to build a dual-purpose reactor at Hanford, Wash., have been dealt a serious—if not final—blow.

The Atomic Energy Commission has assigned final engineering design on the $145-million project to General Electric Co, operator of AEC's Hanford Works.

This apparently signals an AEC decision to go forward despite White House statements that the big plutonium producer—capable of conversion to power production—is not necessary.

The Joint Committee on Atomic Energy pushed through authorizing legislation this year on grounds that additional plutonium-producing facilities are essential if the nation is to go forward with development of small atomic weapons.

President Eisenhower argued in vain that top Pentagon civilian officials had not stated any military need for the plant—although the uniformed chiefs did—and that the power conversion feature was unwarranted in any event.

Although investor-owned electric utilities stayed out of the fight, there was no doubt that many companies are rankled by the prospect of eventual construction of 300,000 kw of new government power generation at Hanford.

In light of the White House attitude, coupled with increasing talk about U. S.-Soviet atomic disarmament, many supporters of the big project expected the President's Budget Bureau to stymie the project by refusing to release necessary funds.

However, AEC officials say they asked the Budget Bureau for an apportionment of $10-million for the first phase—and got it. In fact, there has been no sign that the bureau will withhold funds from any project considered of major importance by the Joint Committee.

• The Southern Governors' con-

Rates and Regulation

- **Railroad power hike sought by Philadelphia Electric**
- **Study starts on Tacoma City Light rate clarification**

Philadelphia Electric Co is seeking a rate increase of about $1.1 million a year on power sold in the Philadelphia region to the Pennsylvania Railroad. If approved by the state Public Utilities Commission, the increase would go into effect Dec. 2, the day after expiration of a contract that has remained unchanged for 30 years.

The power company said negotiations with the railroad were brought on by higher operating costs. A spokesman said no information was available on whether the cost squeeze would bring rate hike applications for other customer classifications.

● Proposed rate increases for Tacoma City Light, the subject of heavy discussion recently, are expected to be clarified by a comprehensive rate study to be undertaken by the New York firm of Ford, Bacon & Davis, consulting engineers.

Completion of the study is scheduled for early November, following a study by the same firm on the economic feasibility of the city's proposed Cowlitz River hydro development. The Cowlitz studies will be completed about Oct. 25.

The Cowlitz project and a rate increase have been linked by E. K. Murray, utilities attorney and member of the board, who predicts a 25% rate hike will be necessary, partly because of the two-dam project, Murray reasons that the utility will require some $3 million a year in additional revenue, over the $12 million it now receives, to finance the Cowlitz project and to pay for normal plant expansion.

A 25% increase is unlikely, since that would place Tacoma City Light rates 11% above the rates now charged by Puget Sound Power & Light Co in areas adjacent to the city, observers pointed out.

● City Council of Houston, Tex., has proposed a city inquiry into rates of Houston Lighting & Power Co, including the utility's controversial electric demand meters. Public Service Director W. Clinton Owsley has recommended that his department start investigation as soon as it completes a current check of Southwestern Bell Telephone Co. The recommendation, the result of a request by Councilman W. H. Jones last August, was referred to the City Legal Department for further study.

● Ohio Power Co's cost-of-fuel clause sought on residential and commercial customers' rates would mean an 18¢ per year hike to average residential users on coal price advances of 11¢ per ton.

● Oral arguments on Illinois Power Co's proposed $4,264,000 a year rate increase were heard last week. Testimony objecting to the company's use of nameplate ratings instead of actual output of generating equipment for reconstruction costs was stricken from the record before previous hearings concluded.

BRIEFS: FPC will begin public hearings on Oct. 21 on revised rate schedule covering electric service by Public Service Co of Oklahoma to Grand River Dam Authority.

Directors of Oklahoma's Grand River Dam Authority voted recently to remove the 5% surcharge on electric rates to agency customers on the fourth quarter of this year.

Pinedale Power & Light Co has asked the PSC for authority to expand its service area around Pinedale, Wyo.

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ference has approved a project to create the nation's first regional interstate compact for nuclear energy. The proposed agreement is described as a means toward maintaining state authority and of averting complete federal control of the peaceful atom. Before becoming effective the pact will require ratification by state legislatures and approval by Congress.

The agency established under the compact would be advisory to the states. Its program would be aimed at "permitting the states to accept the constitutional responsibilities of government in the many facets" of nuclear activities.

● Central Electricity Generating Board has announced plans for a 650-Mw atomic power station—Britain's seventh and largest—in Suffolk County, northeast of London. CEGB has applied to the Ministry of Power and local planning authorities for permission to develop a coastal site at Sizewell, near the town of Leiston. CEGB said that the site is capable of further development beyond the initially planned station of "about" 650-Mw capacity. CEGB has three nuclear plants under way, site work has started for another, and permission to build a fifth has been applied for.

● The Atomic Energy Commission is inviting proposals from industry for development work on a fast breeder reactor concept using a plutonium oxide-uranium oxide fuel cycle. Nov. 3 is proposal deadline.

EEI Visiting Utilities With New Program Plans

The new all-electric promotional program to be sponsored by Edison Electric Institute is now being presented to utilities all over the country through a slide presentation.

Members of the EEI Commercial Division Executive Committee and the new program's policy committee are speaking before utility management meetings and at utility companies to explain the program. It is tentatively being referred to as the "National Electrical Living Program."

Complete plans for the new program will be announced in November.

Member companies of EEI will be asked to contribute about $2.8 million to initiate the national all-electric promotion.

Big Net, Skimmers, Installed

Downstream migrating fish in Snake to be trapped, trucked around Idaho Power Co's Brownlee and Oxbow dams

A huge net, 2,800 ft wide x 120 ft deep, now spans the Snake River between Oregon and Idaho shores about a mile above Idaho Power Co's almost-completed Brownlee Dam.

Purpose of the 700-ton plastic and steel barrier is to prevent downstream migrating fingerling salmon and steelhead from passing through Brownlee's four 90-Mw, 277-ft head turbines or over the spillway. Instead, the young fish will be induced into one of three "skimmers" positioned in the net, sorted by size, and pumped or tankered into tank trucks. Trucked below Idaho Power's Oxbow Dam, now under construction 12 mi downstream, they will be slipped back into the river.

When Idaho Power's Hells Canyon Dam is constructed downstream from Oxbow, the trapping and trucking operation will be integrated to provide upstream and downstream migrant passage encompassing the 35-mi stretch of the Snake from Brownlee to Hells Canyon.

No dams farther downstream on the Snake and Columbia have facilities for bypassing downstream migrants, though all have fishladders for upstream passage. These dams, all of low-head design (around 100 ft or less), permit fingerling passage through turbines and over spillways, with little attrition. But Brownlee's head drop would result in severe injury or death to the fingerlings, due to passage through relatively high-head turbines or the buffeting of the spillway torrent.

Proposed by Conservation Groups

Therefore, Brownlee's FPC license stipulated FPC-approved downstream migrant facilities. The net and skimmer scheme was recommended by the US Fish and Wildlife Service and fish and game agencies of Idaho, Oregon and Washington. Engineering details were worked out by International Engineering Co, San Francisco, which designed Brownlee Dam and Powerhouse. This is the first large-scale trial of this type of "skimmer" method of by-passing fish around high head dams, and its effectiveness will be watched widely.

The net barrier itself is a floating screen of 1/8-in. plastic mesh, backed by 6-in., 2-gage galvanized wire mesh and reinforced by vertical and horizontal 1/2- and 3/4-in. galvanized steel cables. The net is supported by 100 steel pontoons, some as large as 40-ft long x 6-ft diam. Horizontal reinforcing cables are secured to anchorages on each shore. Here, hand winches permit slight and infrequent adjustment of tension to compensate for reservoir level variation.

The net bottom is held in position at 120-ft depth by a three-fold reinforcing cable. This depth is considered adequate to prevent fingerling passage under the net.

Three skimmers are spaced along the net. Each skimmer is a floating fish trap, a 67½ x 30-ft steel barge made buoyant by air compartments. Each has two 15-hp 20,250 gpm main pumps which induce powerful surface currents to lure the fingerlings into V-shaped troughs in front of the traps. The center skimmer will point up-stream, and the others will point at the near shore, since it is believed many fish follow the shoreline.

Fish Are Sorted by Size

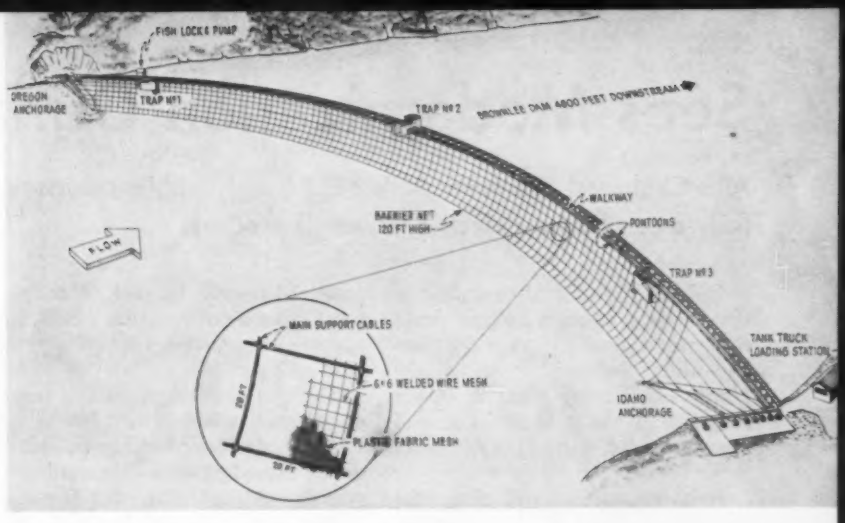
Once into the trap, a fish will follow the currents through narrowing channels, around a hairpin turn, over a series of graduated "sorting slots", and into one of three holding tanks, according to its size. Large fish are hand-netted from their holding tank and transferred to the loading station on the Idaho shore by tanker.

Smaller and medium fish are transferred to the loading station via an 8 in. diam rubber transfer line and a fish lock, in a complex, semi-automatic, remotely-controlled sequence. Every effort is made to prevent injury to the fingerlings. At no time does a fish pass through a pump, and sudden changes in pressure are avoided.

When a holding tank has collected a sufficient number of migrants, an operator starts the sequence from an electrical control panel on the skimmer. First, the rubber transfer line,

NET IS FASTENED to steel wire and cable backing on fabricating barge, floated across river as completed. Fish are trapped in three skimmers

at Brownlee



which can be valved to any small-or medium-sized fish holding tank, is flushed and filled with clean reservoir water.

The skimmer's sorting slots then are automatically closed to entry of fish, and a steel brail—a wire basket lining the holding tank—is raised slowly by air cylinders. As the brail rises, it concentrates the fish in a ever-constricting space adjacent to a slide valve connecting the holding tank to the transfer line.

After the brail has risen 15 in., the slide valve opens, and a 50-hp pump on the Oregon shore begins to pump water from the holding tank via the transfer line through a 12-ft long x 4-ft diam stainless steel cylindrical vessel—the fish lock. Fish that enter the lock are blocked from passing through with the water by a screen. The lock and pump float on a pontoon-supported structure.

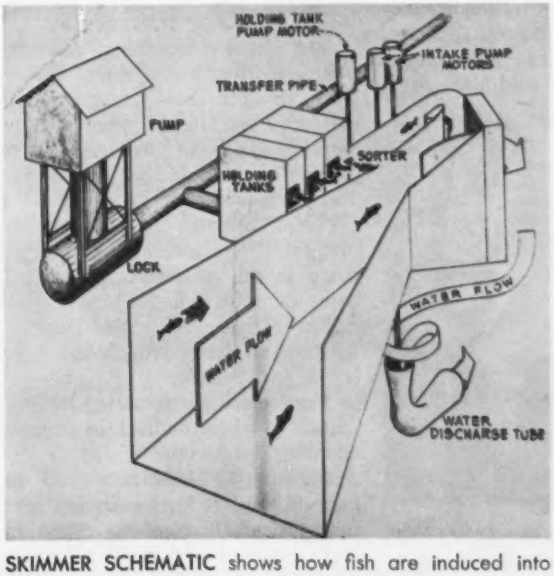
When all fish have left the holding tank and are in the lock or transfer line, the holding tank slide valve is closed. A valving operation at the fish lock reverses the flow of water through the transfer line. The fish lock pump now takes suction from the reservoir and pumps through the lock and the line to the loading station on the opposite shore. Simultaneously, a helical screw device, with hydraulic speed control, moves the fish screen within the fish lock forward, gently urging fish in the lock to enter the transfer line.

At the loading station, a 1,000-gal tank truck has been filled with fresh reservoir water to insure the fish undergo no temperature change. Discharge of the transfer line is over a conventional fish screen which removes the water and allows the fish to slide into the tank truck. The trucks are equipped with aeration and water cooling systems to maintain a proper ambient for the down-stream trip. The same trucks are used in spawning season to transport fish from traps below the down-stream dam to Brownlee reservoir.

The down-stream traps—Oxbow has traps at powerhouse and spillway—are conventional in operation. Upstream migrants, swimming instinctively against the current, enter powerhouse or spillway discharge streams and are induced by artificial cross-currents into the traps. There, they are induced into hoppers which are raised over the tank trucks for transfer.

About 220 motor horsepower is

(*Continued on page* 132)



SKIMMER SCHEMATIC shows how fish are induced into holding tanks, drawn into lock, pumped to loading point

SKIMMER is built ashore, will be floated into place. Intake troughs in front will create 40,500 gpm current

Sees Modernization Outlays Up

Allis-Chalmers' Stevenson tells NELPA only public relations failure can hamper electric industry's progress

Only public misunderstanding or the inability to earn enough profit to attract capital can slow the electric utility industry's growth, the Northwest Electric Light & Power Association was told at its annual convention at Sun Valley, Idaho, Sept. 17-19.

Neither problem will deter the industry, asserted R. S. Stevenson, president, Allis-Chalmers Mfg Co, if sufficient attention is paid to public relations. Pointing to a high opportunity for electric power and equipment salesmen, Stevenson noted that manufacturers this year will spend 56% of capital outlay on replacements and modernization, and boost this to ⅔ in 1961. He linked this trend to the rapid obsolesence of new plants and to rising labor costs. Many Allis-Chalmers manufacturing managers countrywide report inadequate help from local utilities in planning these modernization efforts, Stevenson said.

Tells of USSR Tour

Cordial treatment by the Russian Ministry of Power was accorded the ten American utility executives who recently toured the USSR, according to Edwin Vennard, EEI vice president and managing director. The Americans were permitted to visit any facility, and questions were answered openly, he said. A reciprocal delegation from the USSR is expected to visit US installations next spring.

The best Russian steam unit now operating is a 150-Mw, 2,700-psig, 1,080F machine having an efficiency exceeding 40%, Vennard reported. A 300-Mw, 3,500-psig, 1,080F unit will roll in 1960 or 1961, he said, and a 400-Mw single-shaft machine is on the drawing boards.

About 80% of all power is allocated to industry, Vennard continued, and the spread between generation cost and consumer rates is about double ours, reflecting the government's share in the business. The Russians have developed an individual incentive system, which rewards merit and the achievement of quotas, he said. The US, conversely, is drifting toward socialism, Vennard charged.

An enlarged program for broadcasting basic economic facts to the public was advocated by J. C. Corette, EEI president. ECAP and PIP programs must continue receiving support, he said, but the new educational effort would make use of all media to re-emphasize the limited concept of government upon which our way of life was founded. It would emphasize "government waste, extravagance and high taxes, and the inroads which have been made by government as it competes unfairly with private enterprise," Corette said.

The program would be designed so simply that, if successful, other businesses would be encouraged to follow the utility industry's lead. American business is a political coward, Corette stated, but its participation is essential in the battle for free enterprise.

A federal power monopoly is the last thing we want, declared Fred G. Aandahl, Assistant Secretary of the Interior, local communities should not be dependent on government in Washington for economic opportunities, or for the measure of expansion needs.

Federal hydro is a resulting component of the federal role in a comprehensive water conservation program, he said. It should be marketed to strengthen the area's economics and be "most helpful" to local entities, old and new, that have primary responsibility for power supply and distribution.

Explains Recession

Impetus of the federal multipurpose dam program has carried with it some projects designed purely for power, Aandahl admitted. These could well be developed by non-federal entities, thus strengthening the federal Treasury and the local area's economics, he said.

The national economy, now recovering from a recession, should pass its previous gross national product peak late this year or early next, said J. D. Wilson, Chase Manhattan Bank vice president. But unemployment may still be a problem, although signs are favorable for 1960, he said. Even though there is an inherent bias toward price increases, inflation would show no more than 2% annual increase in the near future, much less than in the past decade.

The recession was caused by four factors: Federal cutback in defense spending, reduction of capital expenditures by business, drop in exports, and reduction in business inventories. Effect of the recession was cushioned by transfer payments

(*Continued on page* 132)

TOM INGLEDOW, BC Electric (on right) was elected NELPA president. With him are (usual order): M. C. Titus, American & Foreign Power; J. T. Kimball, Idaho Power, retiring NELPA president; F. G. Aandahl, Assistant Secretary, Interior

PLAN '59 *Modernize now for growth and profits*

Modernize Transmission to Boost Capacity

DANIEL T. BRAYMER, Assistant to the Editor

The utility industry today is emerging from a period of rapid growth of generating capacity. Now it faces the task of balancing transmission circuit capacity with generating capability, newly-installed and in immediate prospect.

This task will be neither easy nor inexpensive to complete. Transmission systems in the U. S. today are saturated with lines in the voltage ranges below 138 kv; operating voltages more properly related to station and unit sizes of the 1940s than to the 150 to 300 Mw units of the present period.

Moreover, what scant rights-of-way there are in and around major power centers have been already usurped by circuits. In fact, on some systems the time is fast approaching where right-of-way space is more valuable than the limited-capacity circuits that occupy it.

Out of such circumstances come the increasing conviction that higher transmission voltages and conservation of rights-of-ways are twin aspects of the same problem and that they must go hand-in-hand if a prudent balance of transmission and generating capacity is to be achieved.

To the evaluation of this and other areas of transmission obsolescence and the analysis of modernization measures available to meet them the accompanying report is respectfully dedicated.

Is Transmission Capacity In Step With System Growth? ..... p 68
Modernize Loading of Lines and Generators ..... p 72
Increased Circuit Capacity and R/W Conservation Go Together ..... p 74
Substation Patterns are Changing ..... p 79

PLAN '59

Is Transmission Capacity

Transmission systems today seeking to balance circuit capacity needs and generating capability are finding right-of-way scarce and crowded with low-voltage lines

Are today's transmission systems obsolete? If so, to what extent, and in what areas is the impact of obsolescence being felt? Is it growing?

These questions are difficult to answer categorically. But it is demonstrable, that electric power transmission systems in the U.S. today are being subjected to a variety of pressures. Reaction to these pressures is bringing changes in traditional high-voltage transmission and substation patterns that are as revolutionary as they are fundamental to the integrity of future systems.

Prime pressure that is being exerted on transmission springs from the rapid growth of utility generating capacity. In the last decade it has increased from 56,600,000 kw to 145,900,000 kw and is expected to reach 238,000,000 kw by 1965.

Transmission system capacities, keyed to the voltages, conductor sizes and tower designs of two decades or more ago, have not kept pace with this rocketing growth in generating capacity.

As a consequence, the big task facing transmission designers is to restore to prudent proportions today's precarious balance between generating capacity and transmission capability.

The complexity of this task has been increased tremendously because load centers are being served by bigger and bigger power sources, over rights-of-way that are high priced, scarce, and congested, using lines with voltages too low to be effective.

Today there are some 312 more steam power plants in operation than there were 20 years ago. They represent 66,342 Mw of generating capacity in 1,135 units. Moreover, since 1940 the average size of steam power plants in the U.S. has tripled, rising from 30,000 kw in 1940 to 91,000 kw today, and is expected to exceed 125,000 kw by 1961.

Pacing this increase has been a sharp upturn in the size of new steam units installed by utilities. In five years the average size of new units has jumped 96% from 51,000 kw in 1952 to 100,000 kw in 1957 with the prospect of an increase to 181,000 kw by 1961.

As a result of this growth there are some 30 utility systems in the U.S. today with more than 1,000 Mw of generating capacity and another 30 that have between 500 and 1,000 Mw of capacity.

These statistics however do not point up the whole problem being created today on transmission systems. Additional aspects spring from the fact that many utilities are having a harder and harder time acquiring new steam station sites that have adequate fuel and water supplies, and that are strategically located as well. The consequence is that more generation is being put in existing plants with the result that there is a strong trend to generating stations with capacities of 1,000 Mw or more, and unit sizes ranging upward from 200 to 450 Mw and more.

Table I—Transmission Circuit Miles 66 kv and Up—All U.S. Utilities

Kv	1951	1956	% Change
66–75.....	52,170	65,393	25.4
80–100.....	5,324	5,526	4.0
110–120.....	37,799	50,506	33.6
132–140.....	22,169	32,211	45.1
154–165.....	7,278	10,513	44.4
220–230.....	8,715	14,117	62.0
287–288.....	791	1,024	29.5
345.....	.....	1,561	....
Total.....	134,246	180,851	34.6%

Source: Edison Electric Institute

R/W Congested Near Big Stations

Increasingly, systems are being hampered by the inability to get power away from major stations and to load centers at existing voltage over available rights-of-way. Consider, for example, that something approaching 12 138-kv circuits would be needed to transmit the power from a 1,000 Mw generating plant to system load centers.

Thus it is becoming apparent on many major power systems today that conservation of right-of-way is as urgently needed as a shift to 230 and 345 kv. In fact realization that the two go hand-in-hand is inspiring several transmission modernization programs involving complete abandonment of original structures and their replacement with higher voltage circuits and bigger conductors on heavier towers, in order to make high priced right-of-way yield a greater return.

Table I shows the pattern of transmission circuit miles by voltages compared with 1950. It shows that 85% of the nearly 181,000 circuit miles of line operating at 66 kv and up is embraced by voltages of 138 kv and below. Selection of these voltages in the past was frequently related to turbine generator and transformer unit designs of 50 or 60 Mw. Today they are ill qualified to meet the get-away requirements of generating plants where more than half the new capability being added is in units of 150 Mw and larger.

But there is a strong trend to higher voltage transmission. In 1946, for example there were 12 utilities operating lines at 220 kv. Today there are upwards of 25. Moreover, in the 16 years, 1940 through 1956, circuit mileage operating at 220-230 kv more than doubled; going from 6,820 to 14,177.

As Table II shows, extra high voltage transmission at 330-345 kv—the first new voltage to be introduced since the 1930's—is off to a flying start. In 1953 the first 62 miles of 330-kv line were operating. But in 1958 five utilities, in the U. S. and

In Step With System Growth?

Canada have in service or building 2,626 miles of 345 kv line. Four more utilities have 500 miles in immediate prospect.

Pressure on transmission systems is severe. It promises to get progressively worse as new routes must be found through crowded industrial areas.

Measures to conserve existing transmission right of way and make it yield a higher return are finding expression today in many ways.

Where conductor sizes are limiting, and structure strength permits, capacity is being gained by twinning conductors. A half dozen utilities have done this by "peeling" old conductor back on itself for half the length of line thus twinning old conductors with old; new with new.

Modification or elimination of the broken wire assumption on several new tower lines ranging from 138 kv to 345 kv has permitted use of compact tower designs that could be fitted into crowded situations to conserve right-of-way. In most of these instances design is based on the proven fact that new larger conductors do not fail as often as small ones.

Porcelain in a variety of forms is being used on both old and new towers to cut size and so conserve right-of-way. In some instances disc insulators are being used in V configuration to restrain conductor sway and permit use of shorter crossarms under crowded R/W conditions. In other cases strut-type insulators have been used as "outriggers" to hold suspension strings away from towers and permit voltage increases on existing towers in congested industrial areas. Post-type insulators are also being mounted horizontally on poles and used in cantilever to support 69 kv conductors on narrow rights-of-way.

Revolutionary structural changes are taking place in both lines and substations. Sleet and hurricane experience too is having a fundamental influence.

Larger size conductors and use of bundle conductors are reducing the practicability of sleet melting. Emphasis is shifting to measures for detecting, preventing and designing against sleet. Susceptible lines are watched closely and loaded heavily under sleet conditions to prevent ice formation. Emphasis has turned to sleet proof designs using shorter spans and longer middle crossarms that will tolerate galloping conductors without danger of contact.

Sleet experience in the East last spring focused particular attention on static wire design. Factors of safety are being increased by reducing tension. On older lines, larger static wires are being installed and "goat heads" changed. Wires are being moved inboard to increase horizontal separation and prevent sleet laden static wires from sagging down into phase conductors. Steel cores recover but occasionally aluminum strands stretch beyond the yield point and "basket" when sleet drops off.

New Structural Materials In Use

High strength low alloy steels are finding application in towers where weight can be saved as a result of their greater strength and corrosion resistance. Leg sections can generally be reduced $\frac{1}{16}$ in. when high strength steel is used.

Today steel enjoys a commanding preference among utilities over other metals as a structural material for towers and substations. But the installed cost margin has been narrowed enough by price shifts to put aluminum in a challenging competitive position particularly in industrial areas. Here aluminum's corrosion resistance and the elimination of painting costs have been decisive factors in particular cases. At least 14 utilities today have or plan to build aluminum substation structures.

Effects that power system growth are having on adequacy of transmission systems have already been documented. In substations these same pressures

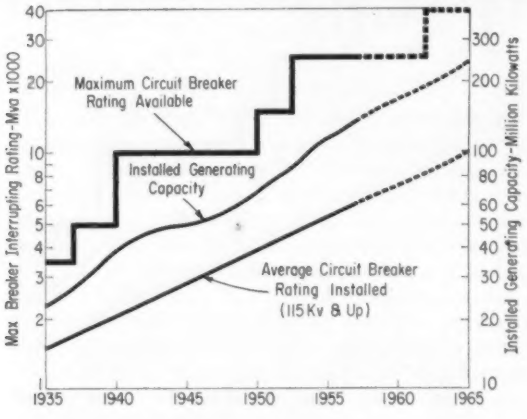
Table II—Utilities Operating Extra High Voltage Systems

Company	Voltage, Kv Rated	Voltage, Kv Max.	Circuit Miles (D = Double Circ)	Phase Conductors No.	Phase Conductors Dia. (in.)	Year
American Electric Power	345	362	1,222 D	1	1.6–1.75	1853
Ohio Valley Electric Corp (OVEC)	345	362	774 D	1	1.6–1.75	1954
Commonwealth Edison Co	345	362	100 D	1	1.6–1.75	1958
Bonneville Power Admin	345	362	335	1	1.6	1956
British Columbia Electric	345	380	195	2	1.108	1957

New Extra High Voltage Systems Planned

Company	Voltage, Kv Rated	Voltage, Kv Max.	Miles	Phase Conductors No.	Phase Conductors Dia. (in.)
Cleveland Electric	345	362	120	2	1.165
Ohio Edison	345	362	100	2	1.108
Pacific N. W. Power	345	362	288	2	1.108
Public Service of Colorado	330	345	...	...	.....

Generating Capacity Sets Pace of Breaker Development



are reacting today directly on circuit breaker interrupting duty, relay speed requirements, power transformer loading and the adequacy of bus systems.

The magnitude of short circuit currents that can be encountered on systems has increased sharply with the increase in generating capacity and the growing emphasis on system interconnection. A demand for larger and larger ratings of power circuit breakers has resulted. The accompanying chart shows that as generating capacity increased from 56,600 Mw in 1948 to 145,900 Mw in 1958 maximum breaker ratings available have increased six fold from 4,000 Mva to 25,000 Mva. An increase in maximum breaker interrupting rating to 35,000 or 40,000 Mva in the next few years appears likely.

Today the average capacity of new breakers installed has increased from about 4,000 Mva in 1950 to more than 6,000 Mva in 1957. These statistics appear to argue that application of available breaker ratings—nation wide—has not kept pace with growth in generation. But this ignores the moderating effect that breaker modernization and split bus operation has on interrupting capacity.

Only breakers being retired today are those built prior to the 1930s whose performance is poor due to lack of adequate reclosing ability, low ratings, old bushings and worn operating mechanisms.

In the past five years, however, breaker modernization has fallen off from its rapid pace during and prior to World War II. Breaker designs of recent years are less susceptible to modernization than earlier models. While modernization continues it is spotty, due apparently to the increased opportunity on expanding systems to shift overdutied breakers to fringe areas where service is less severe.

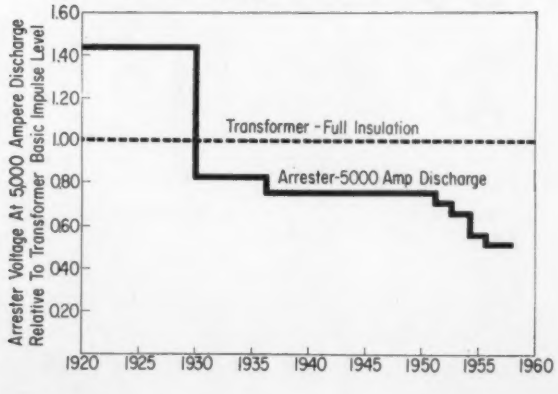
High speed relaying this year is accounting for 55% of relay purchases, manufacturers report. In combination with 3-cycle breakers and fast reclosing it is contributing to improved system stability in the face of heavier line loading.

Evidence of the need for local back-up protection against both relay and breaker failure is appearing on big systems. Stability predictions and failure experience are seen as principal factors favoring installation.

Probable future trends in relaying over the next 10 years are these:

- Fast relay time will be sought; speeds are expected to center around one cycle
- Use of local backup will increase where power concentrations are heavy
- Standardization and simplification will be advanced to promote consistent design and cut costs
- Reduced maintenance will be sought either by extending intervals between maintenance periods or by making maintenance easier
- There will be an increased use of microwave as channel space grows scarcer
- Transfer trip, using microwave and carrier, will continue to be the trend, particularly for multiterminal lines and expanding systems.

Pace of Arrester Improvement Is Accelerating



Power Transformer Retirement Slow

Utility attitude toward retirement of power transformers is revealed in a study of 209 cases involved in one manufacturer's recent search for its oldest power transformer in continuous service.

- 54% couldn't justify retirement economically
- 23% could and did justify it economically
- 23% did not comment

In 49 cases involving units installed before 1911, retirement of 31 could not be justified but 14 could. Capital considerations precluded six, four others were described only as "operating satisfactorily". Another 11 units reported "uneconomical to replace" were in hydro plants with irregular water flow, supplying decreasing loads or lines with voltage due to be discontinued.

Among 65 systems who listed for Electrical World their criteria for scrapping old transformer units the following factors drew top mention: Physical condition, age, cost of restoring to condition, high losses, no further need, obsolete size and failure, in decreasing order.

Looking at the new power transformers being installed in transmission substations to balance the capability of new higher voltage circuits, several trends are evident:

- Transformer ratings are on the increase, ranging upward from 200 Mva and limited apparently only by the capability of transportation facilities. New transformer tractor-trailer rigs are being built to handle 300-ton units. At least one manufac-

turer has announced readiness to build and ship three-phase units of 350 Mva rated 500 kv.

• Although use of three-phase power transformers is standard practice for 80% of new installations today, multi-phase banks still outnumber three-phase installations by a margin of about 2:1. More than half the 1938-'48 installations were multi-phase.

• Out of the trend to three-phase transformer has grown a boom in portable power transformers which in the last 18 months has resulted in the manufacture of an estimated 300,000 kva (over a million kva since 1938) as power utilities sought ways to limit investment in transformer reserves. Over 75% of utilities use mobile units; the average number per system is three.

• About half the new large power transformers sold today in the size range from 15,000 to 50,000 kva have load tap changing gear. In ratings above 50,000 kva there is less use made of LTC gear because most units of this size are in generating plants where few utilities employ the LTC function.

Use of auto-transformers is a continuing trend with almost one-third of installations with nameplate rating of 20,000 kva or larger in this class. The trend is favored by new high transmission voltage systems being superimposed on existing voltage systems, by growth in solid grounding and increased interconnection.

Use of forced oil cooling too continues to increase steadily. Five years ago it represented less than 20% of the installations and less than 40% of the kva. Now it is nearly half the installations, it is reported. Triple rated units have dwindled to 15% of kva and self-cooled to 10% of kva as power company engineers moved to get increased loading from transformer units. Some 75% of installations and 90% of kva in units 50,000 Kva and larger are forced-oil cooled.

The incentive to reduced insulation, or BIL, of transformers springs from savings in cost of units and from reduced losses, lower impedance and reduced weight. Acceptance of reduced insulation of high voltage transformers depends on the voltage. At 230 kv and 345 kv acceptance of 1-step lower insulation levels is 100%, at 161 kv about 65%, at 138 kv 70% but at 115 kv only 25% based on current installations. A recent Electrical World survey of 84 systems found 56% (47 systems) of respondents disinclined to recommend installation of power transformers with 2-step reduction of BIL. But among the 28 favorable disposed, 57% okayed it for 230 kv and up, 14% for 161 kv and up.

A carefully nurtured program of technical evolution over the last 20 years in which arrester development has played a key role, and brought acceptance of reduced transformer impulse insulation to its present level of acceptance. One utility system alone has estimated it 20-year savings from one-step reduction of transformer BIL at $2½ million.

The rate of arrester progress has been most rapid in the past 10 years; sufficiently so from the standpoint of lightning and switching surge protection to suggest retirement of 20-year-old arresters.

More than ever utilities need to avoid the threat to protected apparatus from failure of old arresters in areas of high power concentration. Many substations today are loaded with more arresters of obsolete types than are necessary. Modernization calls for their removal and replacement with fewer modern arresters having improved IR characteristics and ability to extend their zone of protection further than arresters of a decade or more ago.

Are Your Breakers and Relays Modern?

1. Would faster breakers and faster relays improve your system stability, minimize equipment damage, or simplify operation? Yes—— No——

2. Would faster relaying release latent transmission capacity on your system today? Yes—— No——

3. Are switchgear thermal limitations restricting power concentrations in any of your transmission or bulk power substations? Yes—— No——

4. Are breaker interrupting capacity limitations causing you operating difficulties? Yes—— No——

5. Have you considered the advantages of local back-up relay protection to guard against possible apparatus malfunction in areas of high power concentration? Yes—— No——

6. Have you confirmed the effect of high speed reclosing on your system stability? Yes—— No——

7. Are breaker current ratings on your system adequate for present or projected circuit and transformer loads? Yes—— No——

8. Have you had a relay malfunction traceable to any of the following causes in the past 12 months: Relay system inadequacy? Faulty installation? Inadequate maintenance? Yes—— No——

Is Your Arrester Practice Up to Date?

1. Do your present arresters have inadequate margins of protection for equipment they are intended to protect—margins that could be obtained with modern arresters? Yes—— No——

2. Have environmental conditions at the present arrester sites changed so as to shorten the life expectancy of present arresters? Yes—— No——

3. Are present arresters occupying space that is not required by modern arresters—that might be more valuable for other uses? Yes—— No——

4. Have your system and/or operating practices changed such that switching surges could exceed the long duration discharge capacity of the presently installed arresters? Yes—— No——

5. If discharge counters are being used, are there an excessive number of operations? Yes—— No——

6. Do present arresters require excessive maintenance that would be eliminated by installing modern arresters? Yes—— No——

7. Could modern arresters with better protective characteristics protect more equipment (and reduce the number of arresters in a station) than present arresters do? Yes—— No——

PLAN '59

Modernize Loading of Lines

In periods of rising costs, economic loading of lines and generators bring big savings

With increasing costs of labor, equipment, and money, utilities operating under regulated rate schedules, are scrutinizing every contribution to economic system operation. Control of tie lines for enonomy interchange and the control of generators for economic loading are two important ways to modernize system operation and to make money at the coal piles.

To help interconnected systems do a better job of controlling tie lines for economy interchange and controlling generators for economy loading there are five major types of operation in use today.

Mark I—Basic tie line control, working on a limited number of units. There are an estimated 250 such installations on utility systems today.

Mark II—Extension of load control to several stations and many units on a shared basis. Some 30 such installations exist.

Mark III—Load control with manually-programmed economic participation of all major units.

Mark IV—Load control with automatic computer-programmed economic participation of all major units. (In some installations, the computer may be disassociated from the load control system for special studies).

Mark V—Use of special computer to aid load dispatcher.

An indication of the present acceptance of such modern system control and computer facilities as these is given in the list below of electric utilities known to be operating facilities or on order of the Mark III, IV, or V type.

Savings that can be realized through economic dispatch by proper balancing of both generating

Utility Systems Using Economic Load Control Methods

(Mark III, IV and V)

American Electric Power System
Carolina Power and Light Co
Central Illinois Public Service Corp
Central Louisiana Electric Co
Central Power & Light Co
Cleveland Electric Illuminating Co
City of Los Angeles
City of Memphis
City Public Service Board of San Antonio
Commonwealth Edison Co
Connecticut Light & Power
Connecticut Valley Power Exchange
Consolidated Edison Co of N Y
Consumers Power Co
Dairyland Power Co-op
Dayton Power & Light Co
Detroit Edison Co
Duke Power Co
Electric Energy Inc
Florida Power Corp
Florida Power and Light Co
General Public Utilities
Gulf States Utilities
Houston Lighting & Power Co
Idaho Power Co
Illinois Power Co
Indiana-Kentucky Electric Co
Indianapolis Power & Light Co
Interstate Power Co
Iowa Public Service Corp
Kansas City Power and Light Co
Kentucky Utilities Co
Long Island Lighting Co
Middle South System
New York State Power Authority
Niagara Mohawk and New York State Elec & Gas
Northern States Power Co
Ohio Edison Co
Ohio Valley Electric Co
Pacific Gas and Electric Co
Public Service Co of Colorado
Public Service Co of Indiana
Public Service Co of Oklahoma
Public Service Elec and Gas
San Diego Gas and Electric Co
Shawinigan Water & Power
South Carolina Electric & Gas Co
South Carolina Public Service Authority
Southern California Edison Co
Southern Co System
Southwestern Electric Power Co
Southwestern Power Admin
Texas Power & Light
Toledo Edison Co
Tucson Gas Electric Light & Power Co
Union Electric Co
United Illuminating Co
U. S. Bureau of Reclamation, Region 6
Utah Power & Light Co
Virginia Electric & Power
Washington Water Power Co
West Penn Power Co
Wisconsin Public Service

and Generators

costs and transmission losses are substantial. The order of these savings are suggested from experience on the Southern Co system since 1955 with its Mark IV installation, applied to 28 units in 10 plants totaling 2,315,000 kw.

Savings with this computer controlled system have been estimated at $400,000 a year against a $300,000 investment. Transmission losses on the system dropped from 8.33% in 1953 to 7.15% in 1955 and to 7.00% in 1956 despite a 16% increase in power delivered to substations. The result of these savings in transmission losses was a cut of 250 million kwhr a year. At an assumed generation cost of 2.5 mills this would be over $600,000.

While it is not possible to determine what part of savings in transmission losses were produced from economic loading of generation, studies indicated that the 1.18% of generation saved in transmission losses in 1955 resulted from economic loading.

Photo: Niagara Mohawk News

INCREMENTAL LOADER automatically proportions load among Niagara Mohawk units at Huntley and Dunkirk

Is Your Area Regulation Up to Date?

Utilities operating as part of a multiple-area interconnected system i.e., those with regulated ties to adjacent utilities, might ask themselves these questions:

1. Do you meter all inter-area ties and transmit control intelligence by telemetering? Yes—— No——
2. Do you determine the net interchange for your regulating area by algebraic summation of your boundary ties? Yes—— No——
3. Are you coordinating interchange schedules with your neighbors so their algebraic sum for the interconnected system as a whole is zero? Yes—— No——
4. Do you maintain the algebraic sum of interchange schedules equal to zero (see 3 above) even during periods of schedule change? Yes—— No——
5. Are you regulating in your area on a basis of net interchange tie line bias? Yes—— No——
6. Do you have proper bias on your area regulator to match the governing and load characteristic of that area? Yes—— No——
7. Do you take full advantage of the opportunities for interchange with your neighbors? Yes—— No——
8. Is your overall control operation considered adequate by your interconnected neighbors? Yes—— No——
9. Is the speed of response of frequency measurement comparable with tie line measurements so that there is simultaneous measurement of the several factors determining area requirements? Yes—— No——
10. Is frequency measurement of good resolution in the light of very narrow frequency bands that exist on modern interconnections? Yes—— No——
11. Do you use a common frequency offset on all area regulators during period of time error correction? Yes—— No——
12. Do you back up area regulators with adequate, & responsive regulating capacity? Yes—— No——
13. Do you feel your present control causes excessive regulation on your units? Yes——No——

Is Your Operation of Generators for Economic Loading Modern?

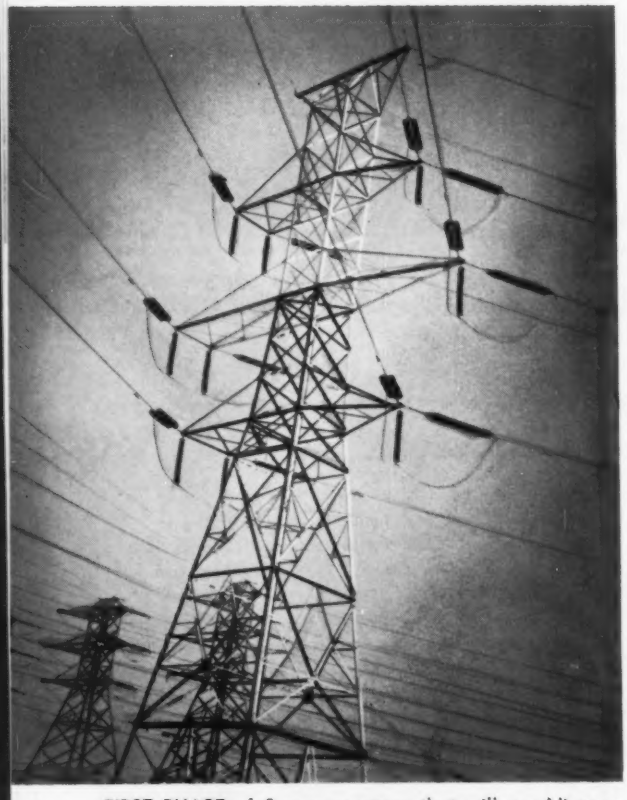
1. Do you presently employ incremental loading schedules to load your system? Yes—— No——
2. Are you automatically adjusting your generation of major units for optimum economy with proper consideration to factors of incremental heat rates, fuel cost, and transmission losses? Yes—— No——
3. Do you periodically determine actual heat rates of your units rather than depend on design or historical data? Yes—— No——
4. Do you have an adequate method of determining your prevailing fuel costs? Yes—— No——
5. Have you made adequate board or digital computer studies of transmission losses? Yes—— No——
6. Do you use modern digital computers in determining your incremental heat rates? Yes—— No——
7. Do you use a modern analog computer in the determination of system economies? Yes—— No——
8. Is your control system able to regulate on all of the plants and units for which it was originally designed? Yes—— No——
9. Do you automatically limit rates of change of generation to boiler capabilities? Yes—— No——

PLAN '59

In Transmission Modernization . . .

Increased Circuit Capacity

230-Kv Transmission System to Top 115 Kv



FIRST PHASE of 5-year program that will see Niagara Mohawk Power Corp build 650 circuit miles of 230 kv transmission is represented by this Huntley-Gardenville tower, part of 280 circuit miles now building

Niagara Mohawk has launched a long range program to build a 230-kv transmission "backbone" from Dunkirk, Buffalo and Niagara Falls in western New York, eastward to Rochester, Syracuse, Utica and Albany; and from Utica northward to Taylorville to connect with lines of the Power Authority of the State of New York.

The program will extend over a period of about five years and calls for some 650 circuit miles of 230 kv line to be superimposed on NM's 115-kv system. Some of the lines will be on existing R/W but substantial new R/W is being acquired. Lines will be single circuit on wood-pole H-frames except in urban areas in the West where double circuit steel towers will be the ruling structures.

Niagara Mohawk's use of 230 kv in preference to 345 kv was determined by the economics of the situation, 230 kv being considered ample for the foreseeable blocks of power to be handled.

Need for the 230 kv system arises from the installation of new major generating units at Huntley (Buffalo) and Dunkirk stations and similar additions in the future at other sites on the cross-state system. The 230 kv system also provides the means of absorbing the large blocks of PASNY hydro power from the St. Lawrence and Niagara projects.

First phase of the program has some 280 circuit miles of 230 kv built or under way in western and northern portions of system, between Huntley and Gardenville (Buffalo) and Packard (Niagara Falls) stations and between Porter Station (Utica) and Adirondack Section near Taylorville. By the time the first of the two new 200 Mw units is installed at Dunkirk in 1959, 230 kv lines will have been extended from Gardenville to Dunkirk.

Philadelphia Upgrades Transmission Voltages

A rebuild of Philadelphia Electric Co's 10-mile Bradford-Newlinville single-circuit line from 66 kv to 132 kv that will replace existing 4/0 copper conductor with 795 Mcm ACSR is being dictated by the need to increase capacity of this H-frame line and make effective use of its 75 ft R/W.

Over the past 10 years Philadelphia Electric has increased voltage on eight different transmission lines aggregating 55 miles. Bulk of these increases have been in the 66 kv class. Henceforth it is anticipated that any new lines will be built for 132 kv but may operate initially at 66 kv.

In the case of the 100 miles of transmission being built in connection with the company's Eddystone Station project, provision is being made for future voltage increases. Some 15 miles are to be 132 kv pipe cable and another 25 miles will be 132 kv construction for initial operation at 66 kv. Ultimately the entire 100 miles will operate at either 132 or 220 kv.

and R/W Conservation Go Together

NEW 220-KV PATTERN that will progressively replace 132-kv lines of PSE&G is typified by these tower lines. At left is new 220 kv tower; at right two 132 kv lines that will be replaced with 220 kv towers under program

PSE&G To Convert 132-Kv System to 220 Kv

As part of a long-range transmission program, Public Service Electric and Gas Company is undertaking a conversion of a major portion of its existing 132-kv transmission system and associated substations to 220 kv. This step is being taken to provide outlet capacity from present and projected generating stations over existing rights of way and insure the necessary interconnection capacity between stations and system load center.

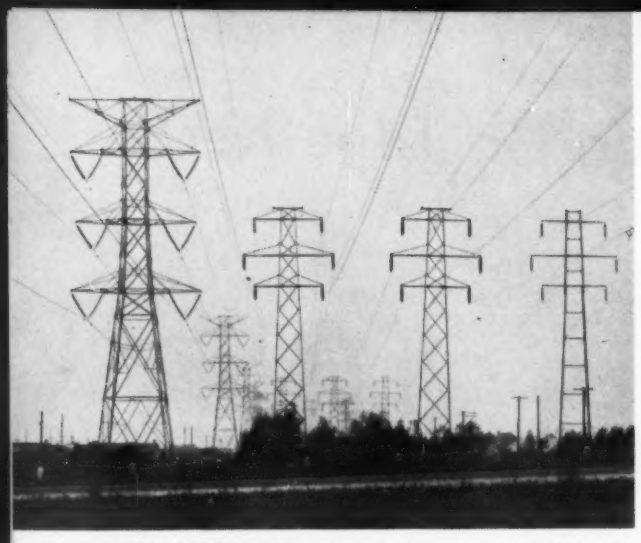
A big factor in the company's decision to rebuild existing 132-kv lines rather than "superimpose" higher voltage on the existing 132-kv system was inability of obtaining new rights of way through a heavily built-up industrial and residential territory. Economic studies showed the greatest possible use of investment in existing rights of way would be made by rebuilding these lines for 220 kv rather than using extra high voltage because of the tremendously high cost of terminal equipment at the higher voltage.

Under the program present 132-kv conductors of 477 and 795 Mcm will be replaced with 1590-Mcm conductors to provide circuit capabilities of 600 Mva at 220 kv for short distances. These conductors will require the replacement of present 132-kv towers with 66% heavier structures.

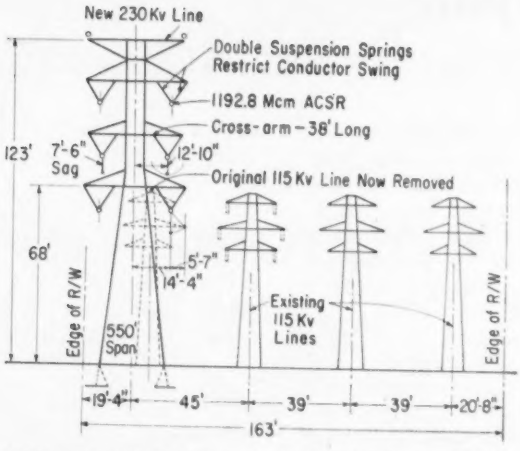
The first phase of the program is now under way with the rebuilding of a double-circuit 132-kv tower line for ultimate operation at 220 kv to provide additional outlet capacity for Linden Generating Station. This ten-mile line will carry 1600 amp per circuit (winter) on 1590 Mcm conductors.

When the company's new Mercer Generation Station is placed in operation in 1960, some 16 tower line miles of existing 132-kv line will be converted to 220-kv operation will provide the necessary transmission outlets. In the process, a double circuit tower line carrying a 132-kv circuit of 477 Mcm conductor making up a portion of the interconnection with the Philadelphia Electric Company will be replaced with 66% heavier double towers and 1590 Mcm conductors insulated for 220 kv.

A second 132-kv single circuit wood-pole H-frame line, now supplying a high-voltage customer, will be replaced by a double-circuit tower line with 1590 Mcm conductors also insulated for 220 kv and extended to the Mercer Generating Station. Over these two tower lines, three circuits out of Mercer Generating Station will operate initially at 220 kv and the interconnection line with Philadelphia Electric Company will continue to operate at 132 kv. These will be the first lines actually converted from 132-kv to 220-kv operation, although by this time several circuits constructed for 220-kv will be in operation at 132 kv.



NEW 230-KV LINE, at left, shares 163 ft R/W with three 115-kv tower lines. Compact design lets it occupy same R/W space as the 115-kv line it replaced



HOW IT WAS DONE is shown here! Compact 230-kv design combine short spans, conductors restrained by "V" insulator strings, and 16 ft shorter crossarms

New 230-Kv Towers Fitted to Narrow R/W

What can be done to provide get-away transmission capacity from an expanded generating station over a right-of-way that is both narrow and already occupied by low-voltage lines is illustrated by Niagara Mohawk Power Corp's new Huntley-Gardenville 230-kv double-circuit line.

In one 4-mile section of this 230-kv line, built to provide outlet capacity for Unit 67 (200 Mw) at Huntley Station, the new double-circuit steel tower line was interposed in the space of a 115-kv double-circuit tower line—one of four in a right-of-way that was 163 ft wide in places.

Construction used on the 230-kv line has three major points of departure from conventional design.

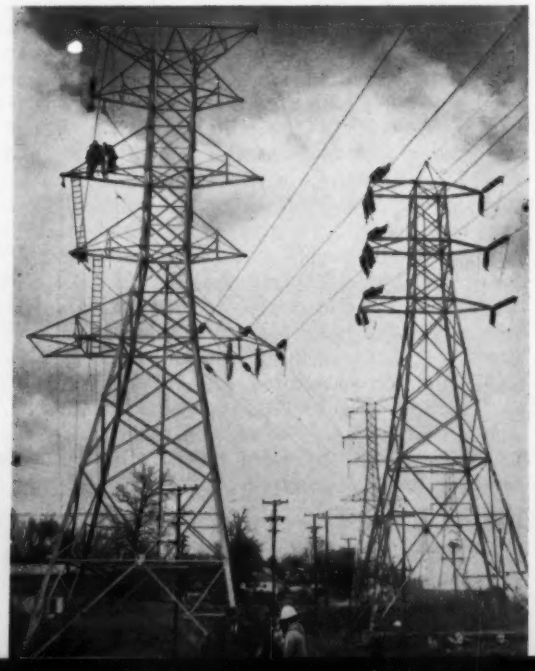
1. Length of the longest crossarm was reduced from a normal 54 ft to 38 ft.

2. Short crossarm length made it necessary to restrict conductor swing at the tower. This was accomplished by means of a double string of suspension insulators in "V" formation.

3. Span lengths were limited to 550 ft to avoid mid-span conductor swing of more than 6 ft.

The accompanying sketch and photograph show the compacted 230 kv construction as well as the lower voltage line that it replaced.

Width of R/W for most of the line is 242 ft.



Four-Circuit Tower Fits Tight R/W With Low Headroom

Towers for tight R/W where both horizontal space and vertical height was restricted have been developed for Union Electric Co by Sverdrup & Parcel, St. Louis consultants, to fit two 138-kv circuits and two underbuilt 34.5 kv circuits into an existing right-or-way. In some places tower footing were less than 1 ft inside the property line. Moreover, the line passed near an airport where glide angle of aircraft limited tower height. Provisions were made to carry the two 34.5 kv circuits in horizontal configuration and yet permit conductor take off from any tower. The horizontal arrangement kept tower height down just enough to meet requirements.

Porcelain Struts Control Clearance

Two-piece strut insulators have been installed on short-crossarm steel towers of a re-conductored 115-kv line by Northern States Power Co to control clearance between conductor and tower. It proved to be more economical and less time consuming than replacing the existing 11-ft crossarms with longer arms.

The small base towers were installed in 1924 as part of the original 115-kv loop around Minneapolis and St. Paul. Modernization of 33 towers in 1958 was accomplished by replacing 4/0 copper conductors with 477 Mcm ACSR conductors, replacing the steel shield wire with 110.8 Mcm ACSR and adding a 5½ ft extension to the tower tops, to improve lighting performance. The shield wire was originally on one side of the top crossarm.

The struts afforded a convenient way to stabilize the conductors and elminate the insufficient clearance to the tower on 30 to 40 deg swings with existing 11 ft arms. Previously wood crossarms with tie down insulators were used at angle-tower locations. Radio interference is expected to be decreased by use of the strut insulators in place of the tie-down arrangement.

AFTER: Strut insulators and extension on rebuilt line

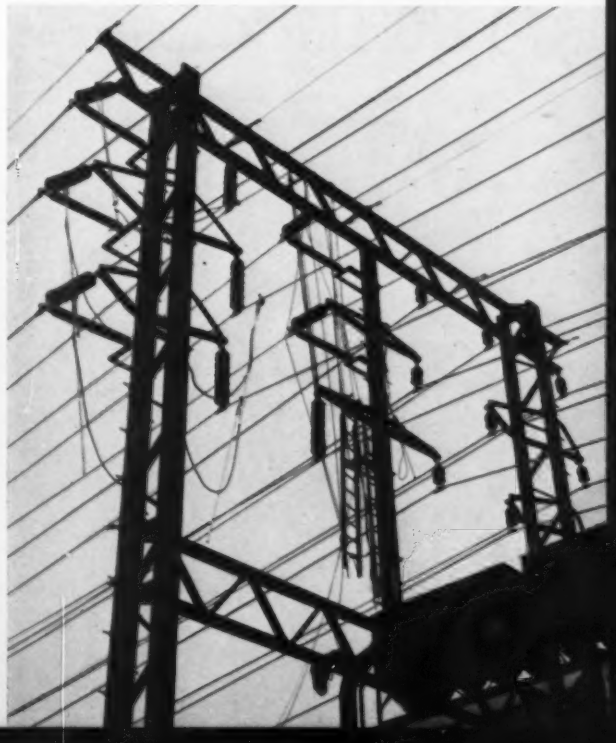
Convert 69 to 115 Kv On Old Portal Towers

Modernization and conversion of a 69-kv steel tower line to 115 kv on the original portal-type structures and within limit of a narrow right of way is in process on 1½ mile portion of the Adams-Harper line of Niagara Mohawk Power Corp.

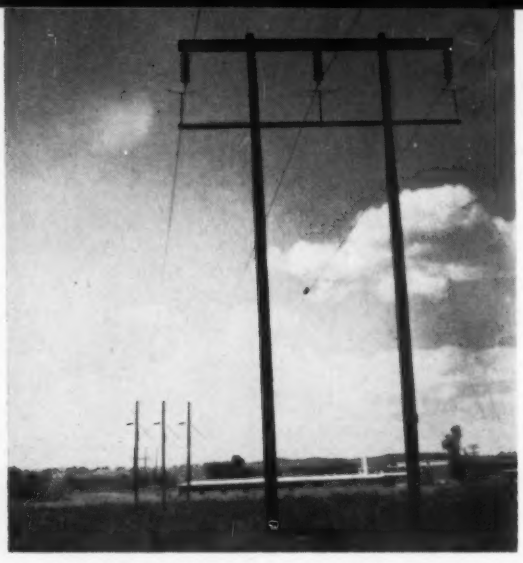
The existing portal structures 33-ft wide were built in the 1920s and supported three 69-kv and three 12-kv circuits. Two 115 kv circuits will replace the three 69 kv circiuts but the 12 kv circuits will remain.

By using solid porcelain strut insulators as "outriggers" it was possible to push the 500 Mcm out into positions of adequate ground clearance and make the conversion to 115 kv without any change in the steel towers. The original 69 kv suspension strings were made up of four 6½ in spaced units. They are replaced with new strings of seven 5¾ in. spaced units, six of them fog-type units.

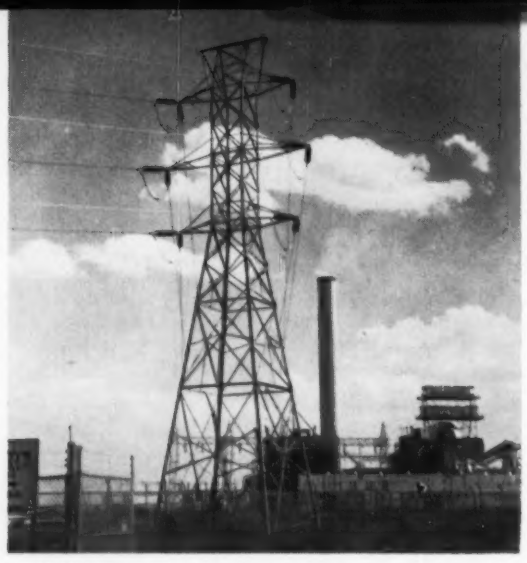
Close clearances to the tower members on the two inner 69 kv circuits made removal of one of them necessary to provide adequate clearance for the inner 115-kv circuit. The outer circuit is suitable for 115 kv by simply repositioning of the conductors through the use of struts and seven-unit strings as shown in accompanying illustrations.



DURING CONVERSION innermost and outer 69-kv circuits, being converted to 115 kv, are pushed out and held at proper clearance by outrigger insulators. The center 69-kv circuit will be removed; 12 kv retained



BUILT IN 1942 under wartime material restrictions this 115-kv H-frame had to be replaced to increase capability



NEW LINE uses double-circuit steel towers; boost R/W ampacity from 300 to 1,340 amperes to meet growth

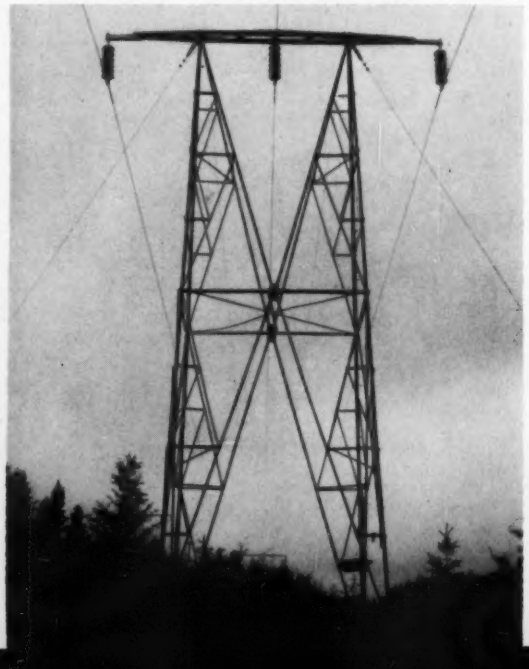
Capacity Needs Force Rebuild of Wartime Line

Modernization of Public Service Co of Colorado's transmission has required replacement of a war-time single-circuit 115-kv wood H-frame line with double-circuit steel towers.

The line is part of the 115-kv belt transmission around Denver, and is associated with a 100-Mw power station, soon to be 350 Mw. Increasing circuit capability and relability was necessary. Original construction of this 6.76-mi 115-kv single-circuit line was H-frame, without ground wires. Half had 3/0 ACSR and half Type-G Copperweld conductor.

The H-frames are being removed from the R/W and replaced with double-circuit steel towers carrying 477-Mcm ACSR conductors and two 3/8-in. overhead steel ground wires. Total R/W ampacity, was increased from 300 to 1,340 amperes.

New Cable Doubles 1910 Line Capacity



Two 100-kv steel tower lines built in 1910 by Montana Power Co are being reconductored from 1/0 hemp-center copper to 336.4 MCM ACSR. Most of the original wedge-type towers and early Type A and D insulators are retained. The modernization approximately doubled line capacity at less than half the cost of new double-circuit lines.

Original towers, weighing only 2,030 lbs, were carefully checked and 75% proved substantial enough to continue in service. About 7% were replaced with wooden H-frame or 3-pole structures. On moderately long spans, supported by the other 18% of the towers, phase spacing was increased to permit adequate clearance for new side guys.

Original insulators, primarily early Types A and D, have been found acceptable mechanically for all tangent and light-angle structures. Only in heavy strain positions and in cases of electrical failure were the insulators changed out with modern 15,000 lb units. Over 48 years about 25% of the original insulators had been changed out.

◀ **BUILT IN 1910—MODERNIZED IN 1958** this 100-kv structure has 24-in crossarm extension to provide clearance for side guys required by wind loading

PLAN '59

Transmission Modernization Shows . . .

Substation Patterns Changing

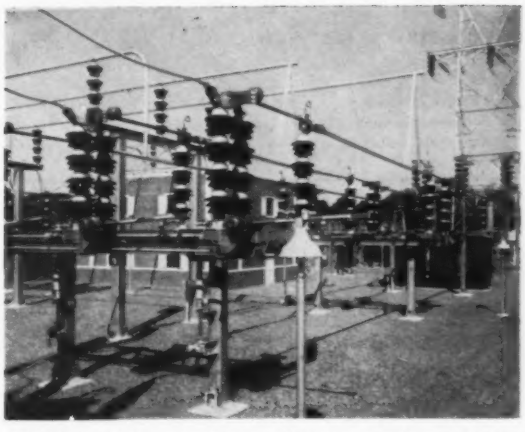
Four Substations Use Aluminum Throughout

In 1958 Philadelphia Electric Co built its first all-aluminum bulk power high voltage substations. They were four in number and not only have aluminum structural members, bus conductors, switch supports secondary junction boxes, but chain link fences of the same material. Data on the voltage, capacity, and date of completion of the new substations are tabulated. Two others are on the drawing boards.

Although fabricated cost of the aluminum structure was higher, elimination of painting, reduction in cost of grounding, erection time and periodic maintenance have resulted in a total cost that favors aluminum structures. Erection time is reduced by about 25% compared to comparable structures previously used. The weight reduction is 80%.

Vertical members are fabricated from aluminum plate, bent and welded to make a square section, in the absence of extruded or rolled sections. But standard shapes were used for top bridge members and welded to vertical supports. Aluminum bus design is based on 4 in. diameter tubular conductors for 132 kv service and 3-phase symmetrical short circuits of 10,000,000 kva.

The Philadelphia utility has been steadily extending its use of aluminum in substations since 1952 when it first used welded aluminum bus at 66 kv at Cromby Station. Present feeling is that any new substations or major extension of existing ones will be made with aluminum as the major metal. This attitude grows out of conviction among responsible engineers that the installed cost of aluminum substations is presently equivalent to and ultimately will be less than conventional construction now in use.



ONE OF FOUR transmission substations built in 1958 by Philadelphia Electric is this Bryn Mawr installation. Structures, buses, switch supports, fences are of aluminum; buses of aluminum standard for five years

Major influence shifting Philadelphia to aluminum substations has been attributed to painting costs and the associated expense of taking apparatus out of service on the average of once in 8 years.

New Philadelphia Substations Use Aluminum Throughout

Name	Voltage-Kv	Capacity-Mva	Completed
Eddystone	20–132	800	October 1958
Llanerch	33, 66–132	170	July 1958
Bryn Mawr	33–132	170	July 1958
Bradford	132	100	August 1958

Corrosion Dictates Aluminum for Coast PUD

Since 1953 when it built two 69/12.5 kv aluminum alloy substation structures in areas where sulphur gases from industrial plants made galvanizing and painting ineffective, Cowlitz Country Public Utility District, Washington has built five more. Three of the last five used bolted- and two welded-type construction. Installed cost of these five substations are compared in the accompanying table (pg 80).

These costs indicate that field welding resulted in a higher overall cost than bolting, despite added engineering required for bolted structures. With welding, all members were detailed for shop drilling with the exception of bracing members installed after the structure was erected aligned and plumbed.

Cost of bolted aluminum alloy structures are equivalent to galvanized steel structures, in place, at 29 cents per pound. Welded structures are equivalent to 31.13 cents per pound for galvanized steel structures.

The advantage of using an aluminum alloy for substation construction are:

1. Economical fabrication by all common processes.

2. Ease and speed of cutting with portable saw.

Installed Cost of Aluminum Structure Substations*
(By Type of Construction)

Construction	Weight In Pounds	Material Cost	Engineering Cost	Labor Cost	Total Cost
Bolted	19,900	$11,269.43	$863.73	$3,053.66	$15,186.84
Cost/Lb–¢		56.63	4.34	15.35	76.32
Percent		74.21	5.69	20.10	
Welded	12,800	$ 7,172.30	$435.62	$2,876.35	$10,484.27
Cost/Lb–¢		56.03	3.41	22.47	81.91
Percent		68.4	4.15	27.44	

Material includes 3 1/3% Washington State Sales Tax.
Engineering and Labor includes 27% overhead and transportation.
* From a paper by R. J. Pangborn, former chief engineer Cowlitz County PUD.

3. Ease of marking and drilling.
4. Available in range of shapes, sizes and alloys.
5. Attractive appearance.
6. Resistance to corrosion in contaminated atmospheres.
7. Excellent electrical conductance.
8. Non-magnetic structures allow terminating of single conductor in closed box without power loss.
9. Resistance to permanent deformation from impact due to low modulus of elasticity.
10. Savings in time of erection due to light weight.
11. Ease of making additions alterations or corrections.
12. High reclaim usage and scrap value.

Series Compensation Ups Circuit Capacity

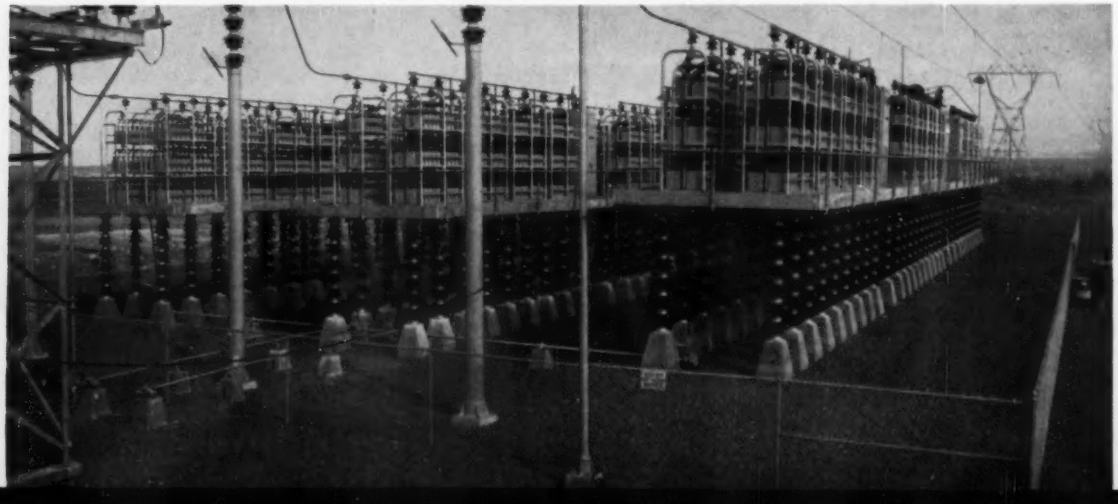
Bonneville Power Administration has 119,490 kvar of 230-kv series capacitors in three locations and will install 108,000 kvar more for a 345-kv line in 1960. Series capacitors will be added to other circuits when loading rises to the point where compensation will economically increase system capacity and produce net savings in real and reactive losses, compared to alternative means.

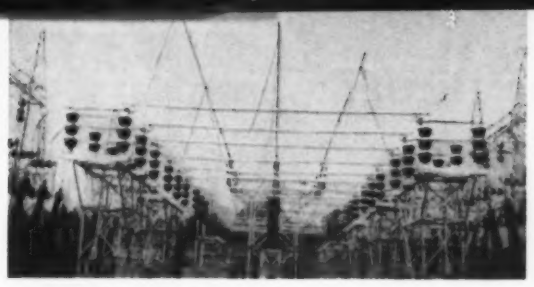
For example, $1,650,000 was saved by adding a third Grand Coulee-Midway 230-kv circuit with 1,272-Mcm conductor and providing 35% compensation instead of building two new 795-Mcm lines. The three circuits, uncompensated, would have been limited by stability considerations to 660 Mw. Compensation, costing $763,350, increased it to 780 Mw.

Further studies show this tie's loading will decrease in time as generation is established elsewhere. Thus the large-conductor/series capacitor alternate combined the cheapest method of increasing tie capacity with the highest salvage value at time of loading decrease.

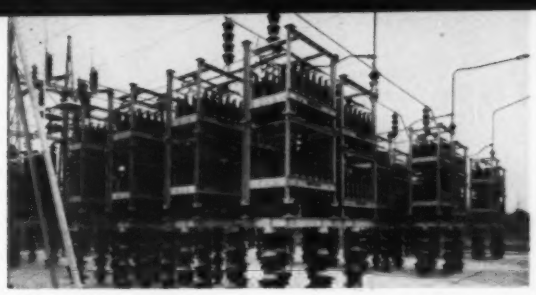
BPA's first series capacitor installation was the 24,090-kvar unit in the 230-kv Chehalis-Longview line in 1951. It reduced impedance of the then-weak Seattle-Portland tie until system conditions improved. Then, showing the flexibility of the series capacitor installation, it was moved to Hot Springs, Montana. There, it can be switched into either of two 230-kv circuits, according to seasonal power demands.

BPA SAVED $1,650,000 by building a 230-kv circuit and providing 35% compensation with this 59,4000 kvar series capacitor at Rocky Ford instead of adding two more lines. Circuit capacity was raised to 780 Mw





CROSS BUS supported on disconnect switches in turn supports main bus at McMeekin Station



SERIES CAPACITORS boost circuit load on Louisiana line 50%, facilitate transfer of large block of power

Bus-on-Bus Saves

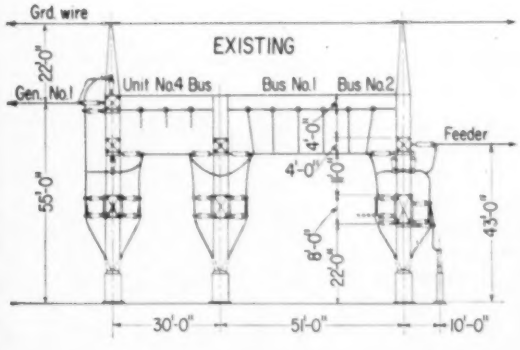
South Carolina Electric & Gas Co has developed a rigid bus supporting arrangement for a substation having a single main bus split with a circuit breaker. Its use at Silas C. McMeekin Generating Station saved about $6,000 through elimination of structures, foundation and associated supports.

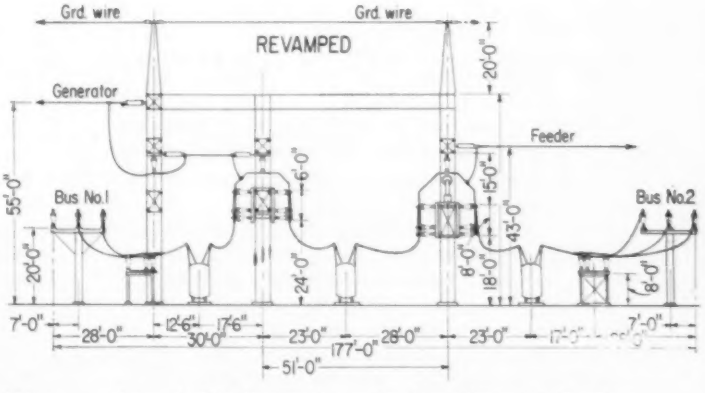
The 115 kv cross busses are supported on two-insulator disconnect switches. The main bus is supported on the cross busses and above it using inverted V's, except at the middle, where two towers are used on either side of the bus tie OCB.

Capacitors Boost Load

One of the largest high voltage series capacitor installations in the world went into service this year at Louisiana Power and Light Co's Bougalusa Station near New Orleans. Rated 57,600 kvar, 115/161 kv and 600 amperes this series capacitor bank makes it possible to increase the circuit load on a new transmission line that parallels a smaller line.

The series capacitors reduce the inductive reactance for the larger conductor of the new line. As a result circuit load was increased from about 60,000 kw to 90,000 kw.





EXISTING AND REVAMPED arrangement of typical 138 kv switchyard bay at Philip Sporn Station was changed from double bus and transfer bus scheme to breaker-and-half pattern to changed requirements

Build New Bus Scheme on Former Structure

Major modifications to the 138-kv switchyard at Philip Sporn Station now in progress, will ultimately make it capable of handling a 1,500,000 kw generating plant, an 800,000 kw aluminum reduction plant load and short circuits up to 15,000,000 kva.

In achieving this, the existing switchyard structure was used with minor modifications. The accompanying cross section of a typical old and new bay indicates what was done and how.

By an ingenious rearrangement of equipment the old double-bus and transfer-bus switching arrangement was converted to a breaker and a half scheme.

Five-inch welded aluminum bus "ground mounted" and having a capacity of 3,560 amp replaced 1,200 amp strain buses of 1,000 Mcm. Disconnect switches with a momentary rating of 100,000 amp replaced 20,000 amp switches installed in 1949.

The simplified switching arrangement will reduce the possibility of switching errors and provide for ease of maintenance on breakers.

Philip Sporn Station is jointly owned by the Ohio Power Co and the Appalachian Electric Power Co.

Test Verifies Adequacy of Rebuilt Breakers

Southern California Edison Co has been modernizing high voltage oil circuit breakers since the early 1930's. As various manufacturers developed improved interruptors, mechanisms and bushings, Edison has applied these advanced components to existing breakers, whenever technically and economically prudent, and practical.

Recently the company developed a verification testing program for both new and modernized breakers. Testing under field conditions, the program proves technical feasibility before Edison engineers accept any specific rebuilding program.

Edison's system borders frequently on other high-capacity systems. Thus low-capacity areas, to which existing outrated breakers can be displaced by new breakers, are limited in number. This, plus familiarity of Edison crews with breaker modification and testing, has enhanced the attractiveness of OCB modernization. At 69 kv, the Company is rebuilding 30 to 50 oil circuit breakers yearly.

Actually, whether to rebuild or to move by displacement always is an economic decision, even when displacement is possible. By advance planning, Edison engineers can place the time when the system is approaching any given breaker interrupting duty. As this time nears, and if the original manufacturer has available parts for increasing rating, an economic study is made.

Basic planning has decreed limit of fault duty on the 230-kv system to 10,000 Mva at all points but one, by high-speed sectionalizing triggered by high-capacity faults. For the past five years, Edison has bought new 230-kv breakers for 10,000 Mva except for the one station which required 15,000 Mva. Economics have shown desirability of rebuilding many existing OCBs to the 10,000 Mva level.

A good example, and the most recent, is a program involving modernization of 41 230-kv breakers from 5,000 Mva to 10,000 Mva, accounting for just under 20% of Edison's existing 230-kv breakers.

Most of these OCBs are around 15 years old, but three, originally rated 2,500 Mva, were installed in 1937. Rebuilding was possible for about half the cost of new 10,000 Mva units.

This particular program has been in progress for several years and has three more to go. The modification consists of installation of interruptor assemblies of new design, incorporating "tulip" contacts in place of butt type, new air-operated mechanisms in place of solenoid mechanisms, and other changes to improve performance. The test program verified adequacy of rebuilt breakers for the new rating.

Survey Guides Bushing Modernization

Rochester Gas and Electric Corp, determined to take maximum advantage of the new ASA Bushing Standardization at the earliest possible moment, has launched a bushing modernization survey.

Under the program company engineers are listing, by voltage classes of all the various types of bushings on the system. A comparable list of equipment in which they are used is also being compiled.

Working with these data and in close cooperation with the bushing manufacturer, a series of adapters have been developed. These will permit new ASA standard bushings to be used for all replacement applications.

Although the problem is complex and involves the assembly and tabulation of much detailed information, it has turned out to be comparably simple of solution. For example; Only two adapters were required to take care of all 69 kv bushings on the system, including breakers as well as transformers. Breakers proved more difficult because the lower bushing terminal must be brought to an exact dimension.

All 34.5 kv class apparatus is also under consideration. While it will take more adapters, the problem still is not too formidable.

The company will soon be in position to take full advantage of the ASA standardization, gradually reducing spares of special bushings.

Relays Guard Against Breaker Lapse

At Linden and Bergen generating stations and ultimately at Mercer Station, Public Service Electric and Gas Co has improved its relay protection by installing special time-delay relaying to guard against failure of a breaker to operate.

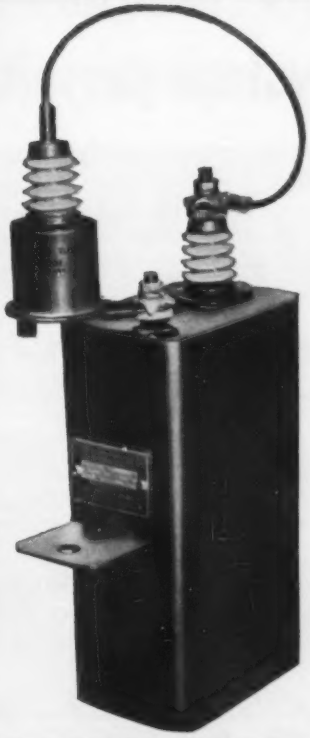
When a breaker does not respond, as a consequence of normal relay operation, a timing relay trips local back-up breakers to isolate the faulty apparatus. Use of this type of relaying is relatively new. First application on the Public Service system was at Linden where vital oil refining processes demand continuous power supply.

As machine sizes increase and power concentrations grow, system stability conditions make rapid clearing of faults mandatory. In even a stuck breaker, this form of local back-up protection selects in a matter of cycles and acts, in a manner similar to bus differential protection, by tripping the same breakers.

ANOTHER GENERAL ELECTRIC

Kilovar Plus . . .

Cap-Gap Solves Distribution Voltage Problems



New General Electric Cap-Gap series capacitor and self-clearing protective gap allows economical loading of voltage-limited distribution transformers and supplies valuable peak-load kilovars

Here's what the new Cap-Gap does for you . . .

- Makes transformers virtually self regulating.
- Improves secondary voltage.
- Solves flicker problems caused by motor starts.
- Supplies peak-load kilovars.

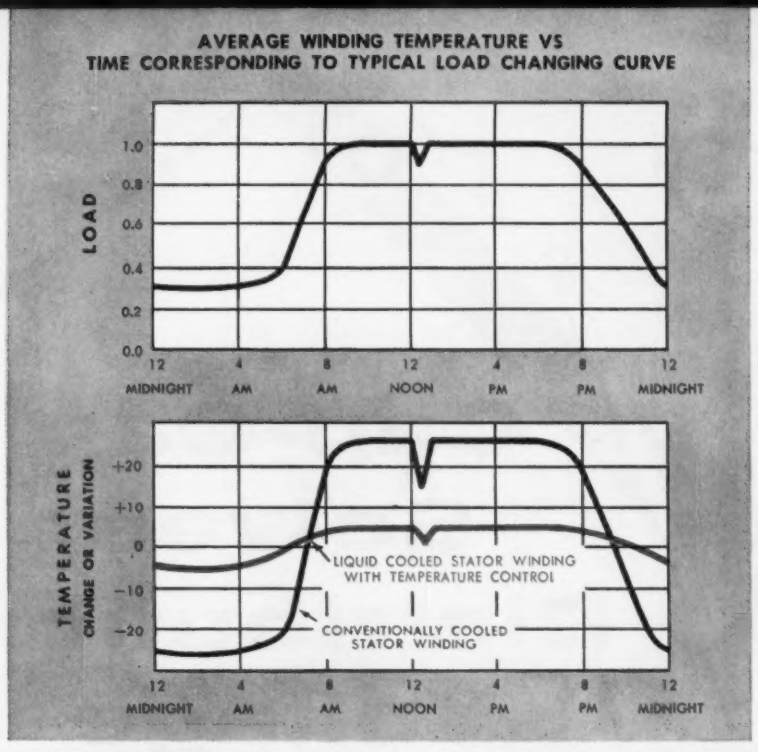
Here's how it works. The Cap-Gap actually cancels transformer reactance. When abnormal voltage conditions exist across the capacitor, a self-clearing gap protects the transformer, capacitor and system by automatically bypassing the capacitor once each half-cycle. It automatically reseals itself and reinserts the capacitor when normal voltage is restored. Cap-Gap units are rated 2, 3, 5, and 7½ Kvar, 240, 480 and 720 volts and can be used with 2400, 4800 and 7200 to 7960 volt distribution transformers 10 to 37.5 KVA.

No maintenance is required. There are no moving parts to wear out and both the capacitor and gap have stainless-steel cases and alumina-ceramic bushings. Cap-Gaps can be easily installed on either old or new distribution transformers.

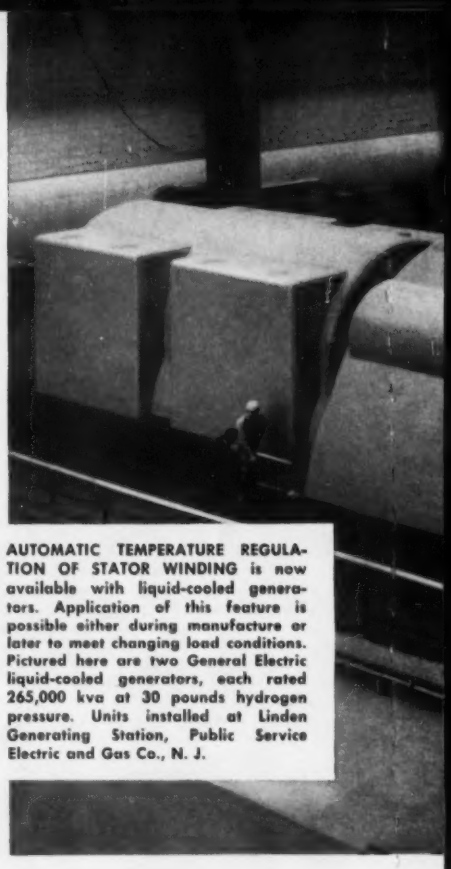
See for yourself how the new G-E Cap-Gap can help you with your distribution voltage problems; contact your nearest General Electric Apparatus Sales representative, or write for Bulletin GEA-6855, General Electric Co., Schenectady 5, N. Y.

445-22

GENERAL ELECTRIC



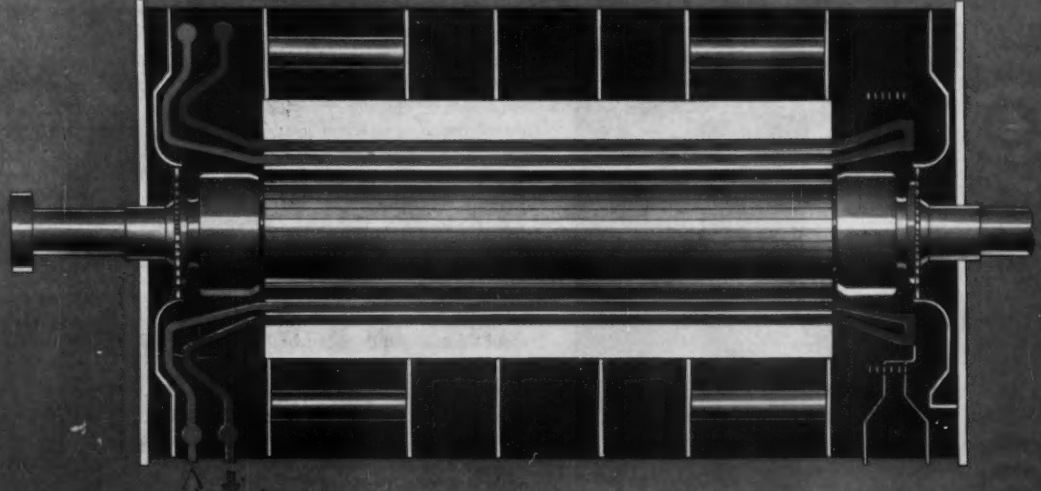
MINIMUM VARIATION OF STATOR TEMPERATURE is possible with liquid cooling, in spite of changes in generator load. Since the liquid coolant is in direct contact with the hollow conductors, the temperature difference between them is only a few degrees. Therefore, by thermostatic control of the coolant, average copper temperature can be kept essentially constant, thus minimizing thermal stress cycling on the insulation.



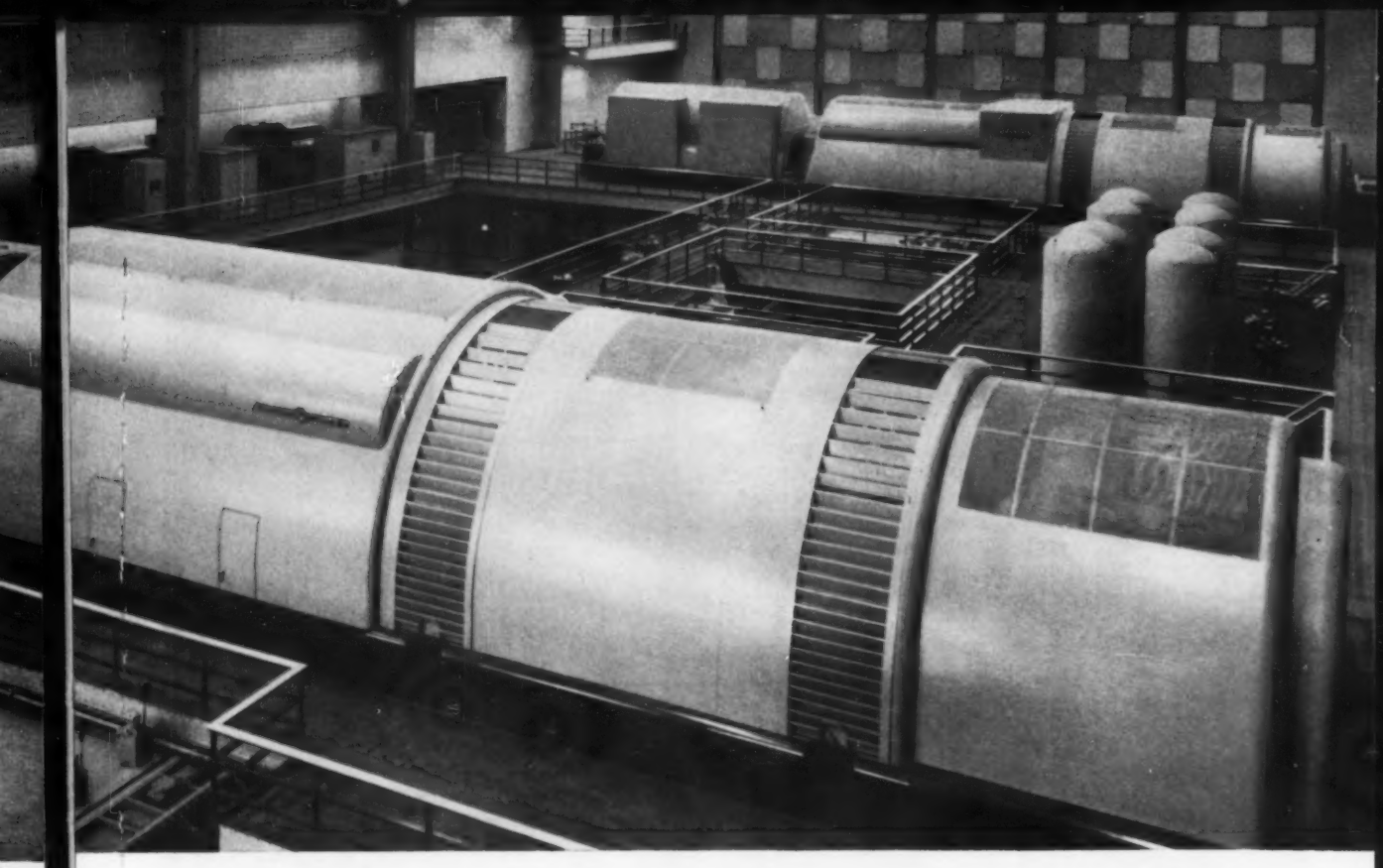
AUTOMATIC TEMPERATURE REGULATION OF STATOR WINDING is now available with liquid-cooled generators. Application of this feature is possible either during manufacture or later to meet changing load conditions. Pictured here are two General Electric liquid-cooled generators, each rated 265,000 kva at 30 pounds hydrogen pressure. Units installed at Linden Generating Station, Public Service Electric and Gas Co., N. J.

WITH HIGHER RATINGS NOW POSSIBLE FOR GENERAL ELECTRIC GENERATORS...

Liquid cooling system permits control of



SIMPLICITY OF THE LIQUID FLOW CIRCUIT adds to reliability. As shown here, highest copper temperature is near the end of the bar, making possible automatic regulation of stator temperature by regulating the flow and temperature of the inlet coolant. Automatic throwover features in the pumping system and other protective devices all contribute to the dependability and continuity of operation of liquid-cooled generators.



stator winding temperature independent of load

REDUCED THERMAL STRESSES HELP EXTEND INSULATION LIFE

In addition to the greater capacity available with liquid cooling, generators may be operated in essentially the same manner established by the successful operation of more conventional machines.

The liquid-cooling system permits generator output to be increased or decreased with minimum variation of stator winding temperature. Since the cooling liquid at the outlet reflects within a few degrees the actual maximum copper temperature of the bars, the inlet coolant temperature may be regulated—automatically—to maintain copper temperature almost constant, regardless of load.

Longer insulation life is the result, since with uniform stator temperature there is much less expansion and contraction of the stator bars. Automatic regulation of stator temperature can be applied most effectively to liquid-cooled machines either during manufacture or later, if desired. This is just one of the many important features of General Electric liquid-cooled generator stators. Other outstanding features are:

***Increased Generator Output**—Hollow strand stator bar construction can remove up to 16 times more heat than conventional cooling arrangements, permitting higher generator ratings.*

***Maximum Efficiency**—Little power is required to circulate the coolant; also a larger cross-section of copper is provided in the winding.*

***Design Simplicity**—Dielectric system maintains the simplicity and dependability of conventionally-cooled machines.*

***Dependable Operation**—Many unique features are incorporated into the design of the closed coolant system to provide a permanently tight liquid circuit.*

***Shorter Maintenance Inspections**—Simple, single-stage, low-pressure hydrogen circulating fans facilitate disassembly and inspection.*

For more information on liquid cooling, contact your nearest Apparatus Sales Office or write for bulletin GER-1231, Large Steam Turbine-Generator Department, General Electric Company, Schenectady 5, N. Y.

254-74

Progress Is Our Most Important Product

GENERAL ELECTRIC

RT&E Builds Transformer for UG Distribution

The Terra-Tran, a distribution transformer designed specifically for application to residential and commercial underground distribution systems, has been developed by RT&E Corp, Waukesha, Wis. Shown are R. D. Nelson, president, and Ed Link, chief engineer, both of RT&E, examining a Terra-Tran rated at 112.5 kva 12,470-208Y/120-v 3-phase.

The transformer completely self-contained, is mounted on a concrete pad above ground level. No separate enclosure or protective equipment is required. To protect the public and linemen from accidental contact, all live parts are enclosed in a locked compartment.

For operation and maintenance, access to the bushings, fuses and disconnects is gained by opening the hinged door on the operating compartment. To facilitate operation, special externally clamped, high-voltage bushings, designed for easy cable connection, and externally clamped low-voltage bushings are used. RT&E engineers report this design offers real economy.

A high-voltage fuse of bayonet design, for isolating the transformer, is supplied on protected-type transformers. The fuse can be removed externally for replacement of the element. In conjunction with this, an externally operated bayonet-type disconnect switch has been developed to sectionalize portions of the circuit.

The Terra-Tran will be available initially in single-phase units in sizes from 15 through 100 kva for operation on 4160/2400 through 12470/7200 grounded Y systems. It will also be available in 3-phase units in sizes 75 through 300 kva for operation on all standard 2400 through 14440-v systems.

PLP to Send Field Laboratory on Transmission Research

The Dynalab, a mobile vibration laboratory, is a new concept that will allow scientific study of vibration phenomena and their effect on energized high voltage transmission lines in the field. It has been developed by Preformed Line Products Co., Cleveland, Ohio.

On an inspection of the research unit in left picture are J. R. Ruhlman (in door), vice president and director of research and engineering, and James C. Poffenberger, his assistant. In the interior view are James Murphy (rear), engineering student, and Dudley P. Mahon, instrument engineer, who helped to build the laboratory.

Preformed's officials believe the Dynalab is another significant step in the company's continuing program of searching out and overcoming the problems of conductor stress

(*Continued on page* 88)

You get delivery in just 8 weeks on RM standard-design medium transformers*

*Non-standard medium transformers (501 to 7500 kva, 69 kv and below) require 12 weeks shipping time.

416-21

General Electric Co., Schenectady 5, New York.

Progress Is Our Most Important Product

GENERAL ELECTRIC

The name Klein on leather goods is known and preferred by linemen and electricians everywhere. Klein tool belts, safety straps, pouches and pockets represent the highest in quality, the safest in design and construction.

In safety straps, Klein-Kord was the first specially woven fabric strap designed to permit the use of a tongue-type buckle without risk of slitting or ripping, even under severe strain.

Now Nylon Klein-Kord safety straps are the newest Klein development offering maximum safety with maximum flexibility. These are the only nylon straps designed to meet the tests given in Edison Electric Institute Report AP-2.

Free Tool Guide
A copy of the new Klein Pocket Tool Guide will be sent on request.

Foreign Distributor:
International Standard Electric Corp., N. Y.

Mathias KLEIN & Sons

PLP Mobile Laboratory (*Continued from page* 86)

and tension. The mobile unit will enable a crew to obtain data on line vibration characteristics as they occur on transmission lines. Hundreds of tiny measuring devices will be connected directly to energized power conductors which will transmit data to the Dynalab where it will be recorded and analyzed. When this information is fed through electronic computers, the statistical data produced will be of practical value to utility engineers in future design of protective devices and construction specifications.

Recording devices in the laboratory will operate largely on an automatic basis, turning themselves "on" and "off" where there is important data to record due to vibration action on the power lines.

The 35-ft by 10-ft laboratory is reinforced structurally to prevent damage in traversing rugged terrain. The forward compartment contains the working area and the completely equipped living quarters are in the rear. All devices in the trailer, including recording instruments, lighting and air conditioning are electrically powered.

The Dynalab will be used at a specific test site for a few months or up to a year.

Sherman & Reilly Designs Lined Sheave

Neoprene-lined conductor stringing sheaves will soon be available from Sherman & Reilly, Inc., Chattanooga, Tenn. One of the permanently bonded sheaves is shown being examined by F. Ward Reilly, Jr., sales manager, and Norman MacLeod, design engineer.

S&R began testing various lining materials last year and ran a series of destruction and wear tests on available materials. Type GNA Neoprene was selected as the most suitable for liners.

A special vulcanizing machine which is used to bond the Neoprene liner to the sheave groove has also been developed by Sherman & Reilly. The machine, shown above, will provide both heat and pressure and will take all sheave sizes 7 through 28 in.

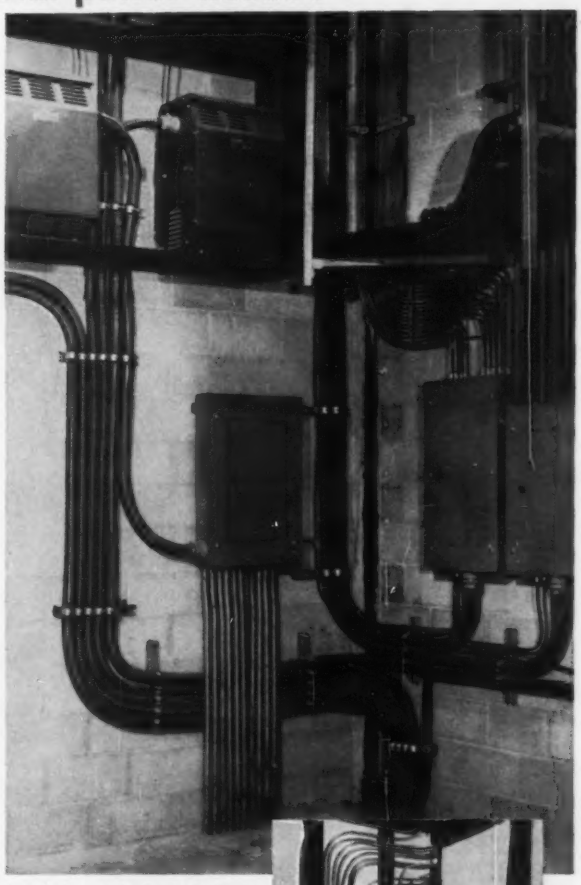
Okonite Furnishes Cable

Okonite Co, Passaic, N. J., has furnished Okonite-Okoprene 600-v power and control cable for Metropolitan Edison Co's Portland, Pa., power station. For station service, the utility is using cable with aluminum Loxarmar finish. Control cable with CM-OT finish is being used for the underground circuits to the transformer and switching station in the yard. Other control circuits have weather-resistant sheaths.

(*More Manufacturers News, page* 92)

the right combination for industrial power needs!

Only General Cable manufactures both...



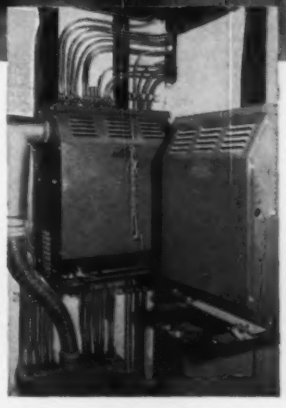
Installation at the St. Regis Paper Company, Jacksonville, Fla. plant.

TYPE M.I. CABLE

for distribution, control and lighting circuits

INTERLOCKING ARMORED CABLE

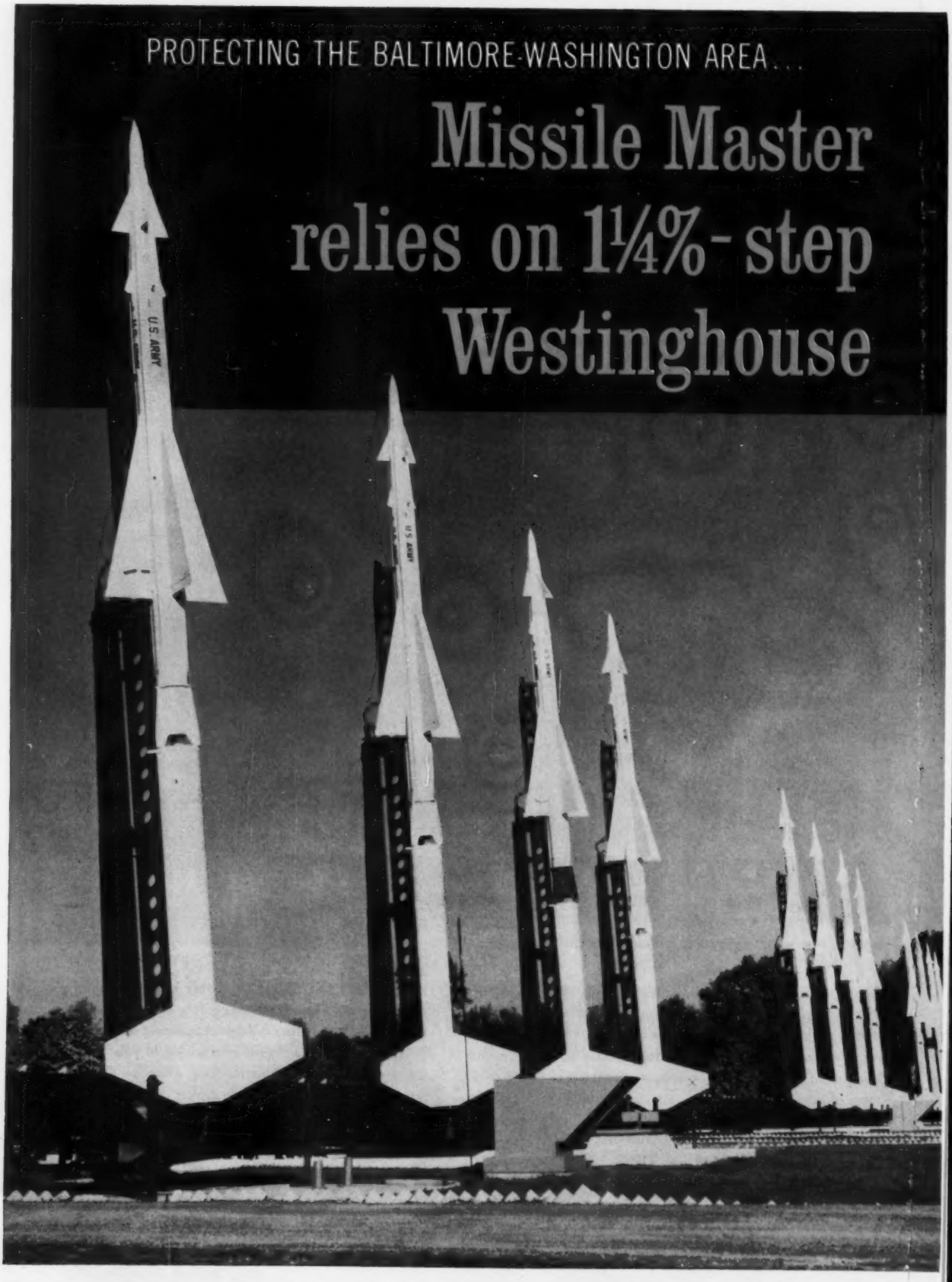
for primary power feeder circuits



Easy to install in all locations, both Safety M I Cable and Interlocking Armored Cable require no mechanical protection, thus lowering costs of installation and minimizing space requirements. These constructions are easy to train around equipment or structural members, assuring the absolute minimum of interference, and present a neat, functional appearance. In addition, Safety M I Cable has unequalled physical and electrical properties: it is completely resistant to moisture, aging, nearly all chemicals, and operates at continuous high temperatures. For truly modern wiring in your plant, specify Safety M I Cable and Interlocking Armored Cable. And remember; only General Cable makes them both.

GENERAL CABLE CORPORATION 420 Lexington Avenue, New York 17, N. Y.
Offices and Distributing Centers Coast-to-Coast

for quality and service... **specify GENERAL CABLE**


PROTECTING THE BALTIMORE-WASHINGTON AREA...
Missile Master
relies on 1¼%-step
Westinghouse
U.S. ARMY

NIKE control system regulation of URL regulators

Missile Master, the first fully operational electronic air defense control system in the United States, now protects the Washington-Baltimore government-industry complex against air attack. Located at Fort George G. Meade, Maryland, Missile Master combines the latest automatic electronic equipment with human supervision at critical points.

Playing an important part in the functioning of the Missile Master installation are 30 Westinghouse URL voltage regulators. The URL combination of 1¼% steps, inverse time delay relay and instant response tap changer keeps voltages constant and reliable.

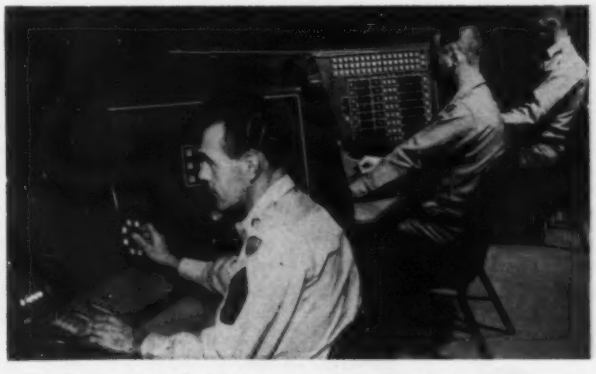
Developed by the U.S. Army Signal Corps Engineering Laboratories at Fort Monmouth, New Jersey, in conjunction with The Martin Company, of Orlando, Florida, this electronic system will control and coordinate the fire of the Army's air defense weapons to insure their maximum effectiveness.

The Missile Master collects information on the location and identity of aircraft, presents this information on electronic displays and distributes this data to the missile firing batteries. Thus, each NIKE battery receives continuous data on all aircraft within the defense area, and on the activities of other batteries. Each NIKE battery commander receives the information needed for proper target selection.

Ask your Westinghouse representative how this same reliability (from either URL or URF voltage regulators) can aid your power distribution system . . . can keep your voltages constant . . . can help you carry greater loads and produce more revenue. Or write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania. J 70891

YOU CAN BE SURE...IF IT'S Westinghouse

Mr. L. J. Huettel, Westinghouse representative, and Mr. B. J. Klaasen, of The Martin Company, inspect one of thirty Westinghouse URL regulators which supply reliable voltage to the Missile Master defense system.



U. S. Army technicians man "friendly protector" console, insuring that friendly aircraft are not fired upon by our missile batteries.

A typical NIKE Ajax Surface-to-Air guided missile launching site.

NOW...
THE LATEST DATA
on
Superformed®
LINE CONDUCTOR ACCESSORIES
IS AVAILABLE IN THE
New FANNER CATALOG

Fanner Catalogs are known for their completeness of helpful information — selection tables, application data, step-by-step installation methods. The new Catalog EP-8 is more complete than ever before. You will see how FANNER's exclusive features, precision manufacturing, protective packaging and color coding work to advantage on a wide variety of applications.

Get acquainted with the products listed on the handy index tabs by sending for your copy of Fanner Catalog EP-8 today. It will prove to be of exceptional value to you!

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PLASTIC FANNGUARDS · PLASTIC INSULATING TUBINGS AND MOLDINGS

GE Reports Advancements in Transformer Field

General Electric Co reduces guaranteed transformer losses without price increase, and introduces smaller substation transformers.

Reductions in guaranteed transformer losses have been reported by GE, effective October 1. They average 10% on all transformers 750 kva and up, and about 20% in the highest capacity and voltage ratings. Exciting currents have also been reduced in like amounts.

The new guarantees apply to all ratings of transformers built by GE's Medium Transformer Dept, Rome, Ga., and Power Transformer Dept, Pittsfield, Mass., and entail no increase in price. The reductions are mainly in the no-load-loss area.

GE engineers estimate that the new loss guarantee will represent a saving of over $1,000,000 to the utility industry in 1959 alone. Pamphlet No. GER-1431A, "Measure Quality of Transformers" can be ordered from GE, Section 421, Schenectady 5, N. Y.

Substation Transformers

A new line of single-phase substation transformers are smaller, lighter, and more efficient in all ratings than models they supersede, according to GE engineers. They are available in standard ratings up to 500 kva, 15 kv.

A typical 250-kva unit, compared to the equivalent 1948 model with tube-type radiators, is 32% lower in height, 42% lighter, and requires 35% less floor space.

Compared with GE's recent panel radiator unit, the new model saves 30% in floor space and 31% in weight.

Improvements are due, said the engineers, to redesigned core-and-coil assembly, and to new manufacturing techniques.

Orangeburg Mfg Co Purchased by Flintkote

Flintkote Co, New York, has arranged to purchase all assets and business of Orangeburg Mfg Co, Orangeburg, N. Y., according to a joint announcement of I. J. Harvey, Jr, Flintkote chairman, and H. J.

(Continued on page 96)

R&IE STANDARD STOCK PLAN

ASSURES PROMPT SHIPMENT OF AIR SWITCHES... FOR INSTALLATION ANY TIME, ANYWHERE

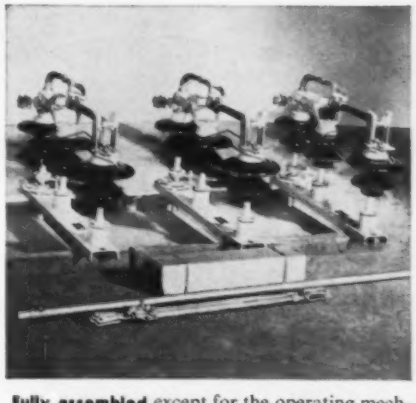
The R&IE Standard Stock Plan gives you maximum flexibility in the purchase of disconnecting and horn gap air switches by assuring their availability when you want them . . . where you want them.

Under this unique plan switches are

1. Ready for final assembly and immediate crating—shipped within 2 weeks from receipt of order
2. Delivered to the installation site without waiting for fully detailed application information
3. Stored at your facilities for instant availability in an emergency

Standard stock plan switches are shipped in kit form. Each kit contains three fully assembled switches, plus all the pipe, fittings, hardware and clear, easy-to-follow instructions for tailor-fitting the operating mechanism at the installation site. Elimination of all factory custom fabrication permits speedy delivery and universal application—limited only by rating.

Standard stock plan switches are available in both horizontal and vertical break configurations in ratings from 7.5 through 69 kv and 600 through 1200 amp. For complete information, contact your nearest I-T-E sales office or write R&IE Equipment Division, Greensburg, Pa. In Canada: Eastern Power Devices Ltd., Port Credit, Ont.

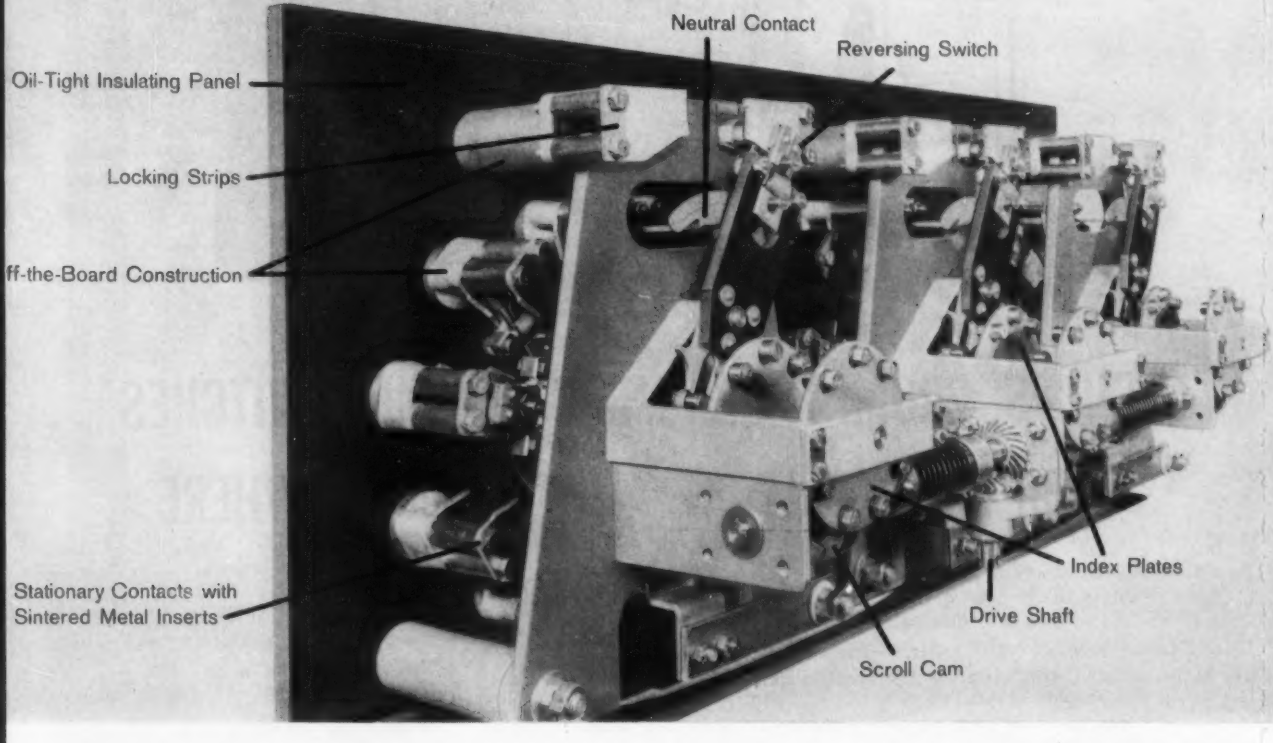


Fully assembled except for the operating mechanism, standard stock plan switches are easy to install. Step-by-step instructions are provided by specially prepared, fully detailed manuals and erection drawings.

I-T-E CIRCUIT BREAKER COMPANY
R&IE EQUIPMENT DIVISION • GREENSBURG, PA.

It's a matter of Cause and Effect . . .

The "550" – a new and better Load Tap Changing Mechanism that can be made for less money.



The development of an entirely new underload tap changer is vital electrical news at any time. But the reduction in the price of the electrical equipment as a direct result of a new and improved design is of *special* significance at this particular time. It is hoped that the combination of these two events will stimulate the purchase of load tap changing transformers in ratings 10,000 kva and smaller.

The facts are simply these: Pennsylvania Transformer engineers have developed, completely tested, and approved an entirely new load tap changing mechanism. Designed around the *direct-drive* principle, it results in a *much simpler,* but at the same, time, a *much more rugged* mechanism that can be manufactured at a lower cost than former spring-drive units. Savings to the user are substantial—averaging between 10 and 15 per cent.

This price reduction presents Electric Utilities with an unusual opportunity to improve service to their customers by purchasing load tap changing transformers more economically and installing them for better system regulation. Referred to as the "550," Pennsylvania's new LTC mechanism has been designed for application on all three-phase, LTC transformers covered by ASA standard C57.12A, on special transformers in equivalent sizes, and in equivalent step voltage regulators.

Qualified sales engineers of Pennsylvania Transformer are alerted to discuss the particular needs of your utility at your own convenience. For appointment write, phone or wire: Pennsylvania Transformer Division, McGraw-Edison Co., Box 330, Canonsburg, Pa. Phone: SHerwood 5-9100.

McGRAW-EDISON

PENNSYLVANIA POWER

Pennsylvania announces lower prices on tap changing transformers in ratings 10,000 kva and smaller.

In the design of Pennsylvania's new Type 550 LTC Mechanism, maximum consideration was given to the following:

1. Positive indexing with mechanical interlocking

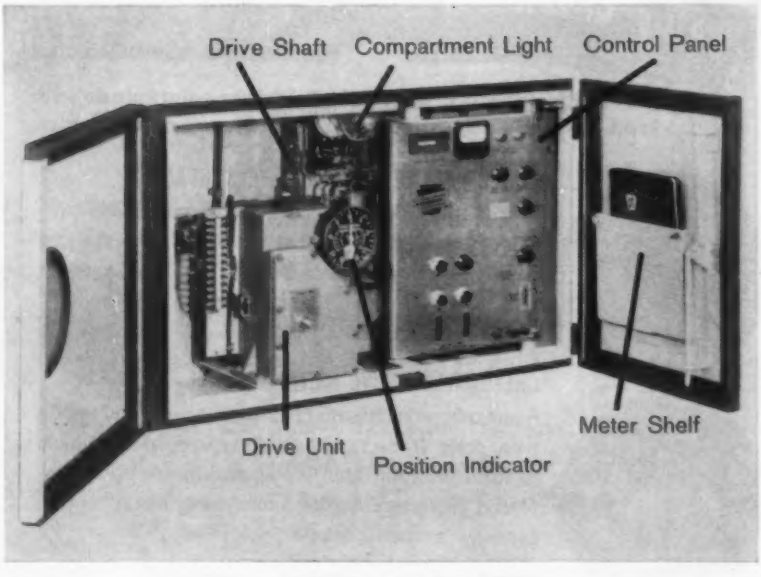
Direct drive of contacts through a scroll cam and index plates inherently insures positive mechanical interlocking. Although the stopping position of the drive is not critical, DC braking of the drive motor is provided to make sure that the contacts stop in the exact position.

2. Efficient arc interruption through controlled contact speed

The movable contacts *start slowly, accelerate rapidly* during interruption, and *close gently* without contact bounce or excessive mechanical shock. This contact speed control is obtained through coordination of the scroll cam design with the design of the gear train.

3. Maximum mechanical life – minimum maintenance

This sturdy mechanism has successfully passed mechanical life tests in excess of two million operations. Particular attention has been given to providing all bolted connections with locking devices.



4. Maximum electrical life – minimum maintenance

All fixed conducting parts in the mechanism are sturdy studs or bus bars rigidly locked in position. Moving contact pressures are individually controlled by coil springs in compression; and rolled copper shunts carry current away from moving contacts. Stand off insulators raise current-carrying parts from high dielectric strength "Pennsylite" to reduce dielectric stress panel on surfaces.

5. Ease of inspection, maintenance and assembly

Hinged doors are provided for air-filled drive/control compartments and oil-filled arc tap switch compartment. Drive and switch compartments consist of subassemblies that are relatively easy to remove and replace.

6. Adaptability to various types of local or remote controls

This includes provisions for hand cranking, automatic control, mounting transmitting unit of remote indicating system, and mounting cam operated auxiliary switches for out-of-step and parallel operation, etc.

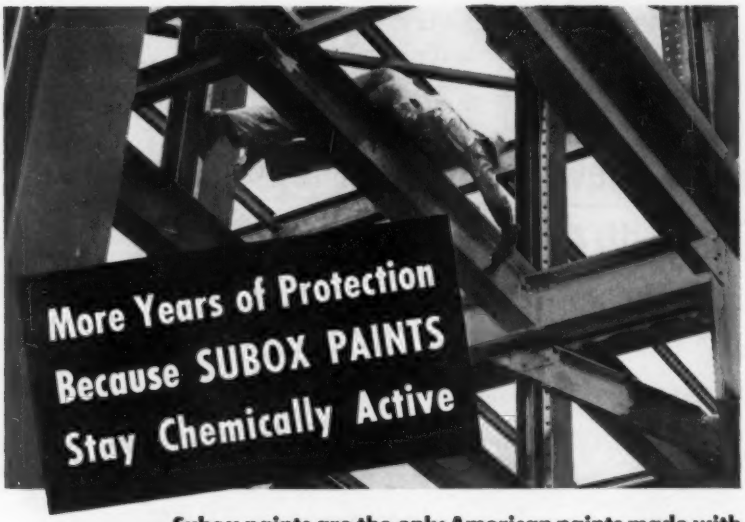
7. Positive oil seals

All gasketed joints in the oil-filled compartment are made by completely retained synthetic rubber gaskets. This includes seal between main barrier panel and main tank, all conductor studs which pass through the main barrier panel, and joints at doors of arcing tap switch.

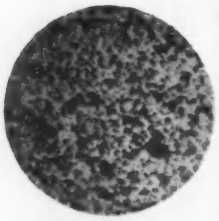
NEW "550" LTC MECHANISM 50% SMALLER AND 75% LIGHTER IN WEIGHT

A comparison of the new 550 mechanism with the unit it replaces shows that in total volume, the "550" is half as large as the former unit. But an even greater difference shows up in total weight. The "550" including oil, weighs only 25% as much as the old unit.

TRANSFORMERS

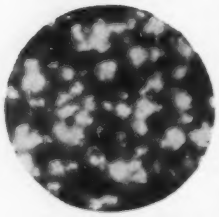


Subox paints are the only American paints made with lead-suboxide. They give extra protection at no extra cost.



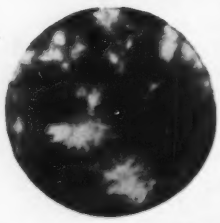
SMALL PARTICLES PENETRATE SURFACE

Maximum penetration is achieved because lead-suboxide is a colloidal pigment. Its film is so dense and impervious that two coats of Subox usually equal three coats of other paints . . . often one coat of Subox is sufficient.



CHEMICALLY-ACTIVE METALLIC FILM

Lead-suboxide remains chemically active after Subox paint dries. It reacts with the fatty acids of the vehicle to form insoluble lead soaps, and builds up a reinforced protective film of intertwining metal-bearing fibers.



FIBROUS COAT IS STRONG ADHESIVE

The fibrous film of Subox gradually strengthens and replaces the original vehicle film (which otherwise would become brittle), and creates a strongly adhesive protective coating with an inherently longer life than that of other paints.

Dark areas in above photomicrographs show how pigment increasingly intertwines to form dense, protective film.

In addition to its other advantages and economies, Subox also saves on eventual repainting. The need for expensive scraping and repriming is largely eliminated.

Available in wide color range. Write for color card and the brochure "Subox Paints".

SUBOX PAINTS

Subox Inc.
Trade Mark

Established 1924
3 Fairmount Plant
Hackensack, N. J.

Flintkote Purchases

(Continued from page 92)

Robertson, Orangeburg president.

Flintkote's plan calls for the exchange of 132,146 shares of a new class of $4.50 Series A Convertible 2nd Preferred $100 par stock for the Orangeburg business. New stock would be convertible into Flintkote common based on $56 per common share, subject to antidilutions.

Harvey said Orangeburg would be operated as a Flintkote division and its identify maintained. Robertson added that operating as an independent division reflects a continuity of Orangeburg sales policy, management, personnel, and plant facilities.

A-C Reveals Four Transformer Developments

Allis-Chalmers Mfg Co, Milwaukee, Wis, announces four recent developments in the transformer field.

• Design changes now make A-C vault network transformers lower, lighter, and more compact, and size and weight have been reduced about 15%, according to the company.

The new tank design increases cooling area over conventional tubes and its corrugated surface makes for a stronger tank. Maintenance is easy because all of the tank's radiating surface is accessible for painting. End corrugations are notched to form lifting hooks.

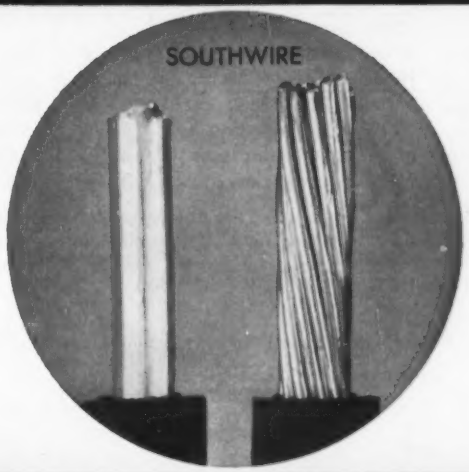
All transformer accessories are located in the same work area so that testing and periodic inspection can be carried on conveniently.

Welding is used wherever possible to eliminate gasket maintenance by keeping bolted openings to a minimum. New core steel applications and new insulator techniques make the compact design possible.

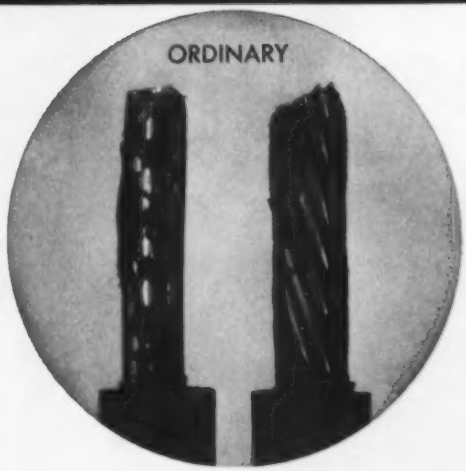
• The first substation transformer for the Wisconsin Electric Power Co's new 230-kv transmission system is scheduled to go into operation next year. The 290/460-Mva, forced oil-cooled, auto-transformer will be installed at the company's Bluemound substation, west of Milwaukee. It is capable of carrying 290 Mva with a future

(Continued on page 100)

100% FREE STRIPPING



ACTUAL UNRETOUCHED PHOTOS
ENLARGED THREE TIMES
SHOW THE DIFFERENCE



Southwire NEOPRENE covered copper wire

- **Strips Many Times Faster**
- **No Scraping Necessary for Connections**
- **No Sticking or Discoloration**
- **No Premium in Price**

ANOTHER SOUTHWIRE FIRST!

The one single headache associated with Neoprene Covered Copper Wire—sticking and discoloration—has been eliminated by Southwire. After three years of exhaustive research, testing, and development, Southwire now provides a completely new compound that is 100% free stripping. None of the manifold advantages of Neoprene covering have been sacrificed. You get a far superior product at no premium in price when you specify Southwire Neoprene Weatherproof Copper Wire.

• FREE SAMPLES AND TECHNICAL DATA ON REQUEST

SOUTHWIRE serves the world

with these quality products:

- Bare and Weatherproof Copper and Aluminum Line Wire
- Neoprene, Polyethylene, and VWP* (Vinyl) Weatherproof Copper, Aluminum and Triplex
- U.R.C. (DBWP, TBWP) Copper
- Copperweld® Conductors
- Copper and Aluminum Building Wire
- ACSR and All Aluminum Cable
- Galvanized Steel Guy Strand and Static Wire
- Aluminized Steel Guy Strand and Static Wire
- Aluminum Alloy Wire
- Cable Accessories

Southwire® Company

TErrace 2-6311 CARROLLTON, GEORGIA

Specify safety, simplicity, ease of installation and maintenance with G&W high voltage (69 to 230kv) cable terminating devices

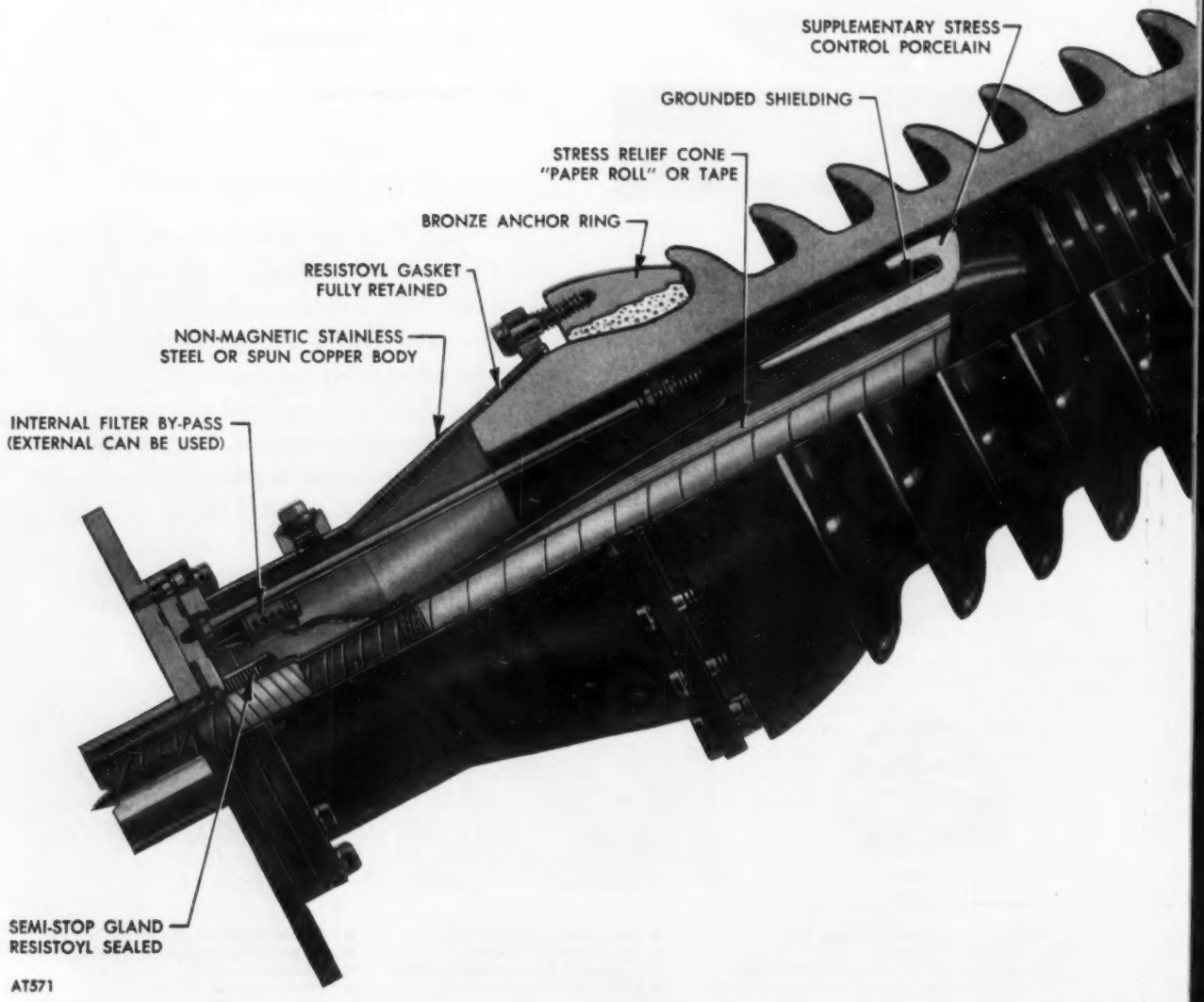
FEATURES

- SIMPLICITY — A minimum of parts, each designed for maximum function.
- VERSATILITY — Method of fabricating base readily adapts it to varying installation conditions.
- NO CASTINGS — Points withstanding pressure, top and bottom fittings, are fabricated non-magnetic stainless steel and spun copper to eliminate hazardous brittle, porous nature of castings that are susceptible to leaks.

- G&W tests exceed A.I.E.E. withstand tests

230kv pothead terminating 1/C, 500mcm, 230kv, PILC, HPOF cable	A.I.E.E. No. 48	Actual Tests
Impulse, 1.5 x 40ms	1050kv	1232kv
60 cycle, 1 minute dry	545kv	575kv
60 cycle, 10 seconds wet	445kv	545kv
60 cycle, 6 hours dry	315kv	340kv

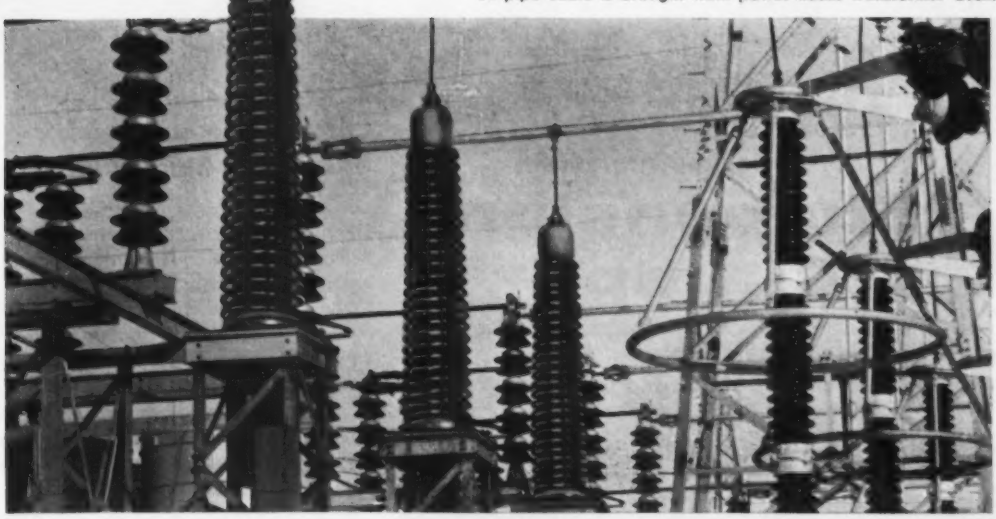
The sound engineering principles of G&W potheads will eliminate the complexities of your cable terminating problems. Their safety, ease of installation and minimum maintenance are essential requirements in which you'll be interested. Notice the features and overall design pioneered by G&W. Specify them with confidence in your plans for high or low pressure oil or gas filled cable systems.


SUPPLEMENTARY STRESS CONTROL PORCELAIN
GROUNDED SHIELDING
STRESS RELIEF CONE "PAPER ROLL" OR TAPE
BRONZE ANCHOR RING
RESISTOYL GASKET FULLY RETAINED
NON-MAGNETIC STAINLESS STEEL OR SPUN COPPER BODY
INTERNAL FILTER BY-PASS (EXTERNAL CAN BE USED)
SEMI-STOP GLAND RESISTOYL SEALED

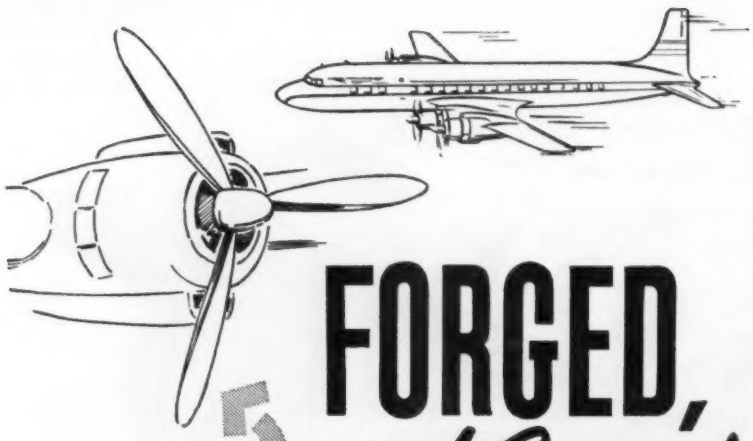
AT571

STANDARD VOLTAGE RATINGS AVAILABLE
69KV — 92KV — 115KV — 138KV — 161KV — 230KV

The first 230kv pothead installation in the U.S.A. — Garrison Dam, North Dakota. Potheads are installed in switchyard where oil pipe cable is brought from power house transformer deck.



G&W ELECTRIC SPECIALTY COMPANY
3500 W. 127th ST., BLUE ISLAND, ILLINOIS



FORGED,
of Course!

LIGHTER
STRONGER TOUGHER

Drop Forged Aluminum

BTC® Suspension Clamps

Wide range of sizes
Superior resistance to shock and fatigue
Positive holding power
Specify the best — BTC Hi-Line Hardware

THE BREWER-TITCHENER CORPORATION
HI-LINE HARDWARE DIVISION • CORTLAND, N.Y.

A-C Developments

(Continued from page 96)

dual cooled rating of 460 Mva.

The 400,000-lb transformer will link the utility's proposed 230-kv transmission system to its existing 138-kv transmission lines. Power will be received from the No. 5 turbine-generator now being built by A-C for the Oak Creek power station of the utility.

• Engineering has been completed for two 192-Mva transformers for Pacific Gas & Electric Co's Pittsburg, Calif., generating station. The forced oil-cooled 18/230-kv transformers are for Unit No. 5. Installation is scheduled for early next year. Insulation in each transformer's high-voltage windings is to be reduced two full steps to 750 BIL.

The Electro-Cooler systems of the two transformers will be arranged so that all coolers can be used on one unit in case of emergency or maintenance which requires outage of one of the transformers. Then either unit can carry 265-Mva.

• Three 75-Mva transformers have been shipped to Houston Lighting & Power Co's new turbine-generator No. 2 at the W. A. Parish Steam Electric Station in Fort Bend County, Texas. The units are duplicates of three transformers shipped last summer for generator No. 1.

The single-phase, forced-oil to air-cooled 19/138-kv transformers are connected to a 165-Mw generator and are equipped with standard Electro-Cooler units.

Alcoa Reduces Price on Aluminum Magnet Wire

Aluminum magnet wire has become available at a lower price, according to the Aluminum Co of America, Pittsburgh, Pa., which has placed a new line of aluminum magnet wire on the market. Potential use is in such devices as motors, solenoids, and generators.

Alcoa has made an arrangement with Rea Magnet Wire Co, Inc., Ft. Wayne, Ind., whereby the latter will manufacture and sell the magnet wire as an Alcoa product. The wire will be offered initially in AWG sizes No. 12 through No. 24 on spools or in pails.

NEW

JOINS 26% FASTER

Because there are no separate couplings to assemble on the job, Orangeburg's new CA Conduit lays faster—costs less to install. In addition, there are no coupling cartons to handle, transport or store.

Orangeburg's new CA Conduit comes, at *no extra cost*, with a factory-attached coupling at one end and a standard 2° male taper at the other end. To join—CA's long, lightweight lengths are placed end to end—hammered home in a simple, one-step operation. Actual installations *prove* Orangeburg's new CA Conduit joins up to 26% faster!

What's more, because the attached coupling is *flush* with the outside diameter of the conduit, new CA Conduit is easy to handle and store in neat, even stacks. And with the new flush coupling there's no need to "stagger" conduit joints in the trench. That means less cutting and tooling time.

New CA Conduit—like the millions of feet of Orangeburg Fibre Conduit in use since 1893—has self-sealing joints and impermeable walls that make it absolutely watertight. Its smooth 100% fibre raceway adds years to cable life.

Specify new CA Conduit on your next job. This addition to Orangeburg's line is available in 2", 3", 4", 4½" and 5" sizes. Orangeburg's Standard and Nocrete Conduit with separate sleeve couplings are available as always. Orangeburg Manufacturing Co., Inc., Orangeburg, N. Y. and Newark, Calif.

Orangeburg Fibre Conduit is distributed by Graybar Electric Co. and General Electric Supply Co. with branches and stocks in principal cities.

NEW

tubeless

photoelectric lighting control

PROVEN by 27 million unit-hours in the field

GUARANTEED unconditionally for two years

FISHER-PIERCE
series
6600A
ACTUAL SIZE

The Model 6600A shown is the basic unit in the 6600A Series. The electronic head, which contains a practical minimum of components, is enclosed in a weatherproof plastic globe. The base is fitted with a three prong twistlock plug in accordance with proposed EEI-NEMA specifications for twistlock adaptations. The five additional models all incorporate this basic 6600A unit, with appropriate additional fittings for various mounting requirements and for interchangeability with existing equipment.

GUARANTEE

Two-year unconditional guarantee from date of installation, except where mishandling, negligence or direct lightning stroke is cause of failure.

By mid-1958, 60 utilities throughout the country had more than 7000 Series 6600A controls in actual field service. Four years had been spent developing the basic control, testing cadmium sulfide cells and other components, and incorporating the results of operating experience into the design. The single reason Fisher-Pierce did this — *before* offering the control for general sale — was to assure themselves of the *dependability* of the 6600A. The objective was not "to be first" with a tubeless control; instead, it was to achieve true *reliability* in a low-cost, compact unit. The performance of the 6600A now bears out the soundness of this conservative approach.

The 6600A embodies a highly simplified, efficient circuit in a rugged, compact package. No tubes or transistors are used; a CdS photoconductive cell operates a special Sigma relay directly. Major operating specifications and characteristics are briefly listed here, together with a summary of the six 6600A Series models available for various mounting requirements. For more complete information, write The Fisher-Pierce Co., 82 Pearl Street, So. Braintree 85, Mass.

Primary Features

Circuit design of Series 6600A controls reflects conservative derating of all components and thorough attention to protective features. For example, the CdS cell operates on AC and its power dissipation never exceeds 70% of its rating, to insure longer life and greater stability. Also, protection of the cell from direct sunlight and more uniform, dependable turn-on are afforded by control design intended for directional operation.

- Hermetically sealed, broad area cadmium sulfide cell. Every cell is pre-aged and 100% inspected against specifications which resulted from extensive field tests.
- Sigma relay specially designed for use in this control.
- Built-in expulsion-type surge and lightning protection.
- Delayed circuit response prevents false operation due to lightning.
- Weatherproof plastic housing — not susceptible to discoloration, cracking or crazing.
- Metal parts are corrosion-resistant.
- Fail Safe Operation: lighting load will remain turned on in event of failure of electronic circuit.
- Humidity Tested to 100%.

Model 6600A — luminaire or slipfitter mounting (twist-lock receptacle, for bases up to 3" in diam.)

Primary Specifications

Supply Voltage	105-135 volts, 50/60 cycles
Load Rating	1000 watts, incandescent, mercury vapor or fluorescent
Inrush Current Rating	100 amperes
Standard Factory Setting	Turn-on 1.5 ± .5 foot-candles Turn-off 1-2 foot-candles higher than turn-on (Other settings available on order)
Power Consumption	less than 0.5 watt average (0.9 watt max. daytime, 0.06 watt max. night time)
Temperature Range	−55°C to +70°C (−65°F to +158°F)
Weight (basic 6600A control)	8 ounces

FISHER PIERCE

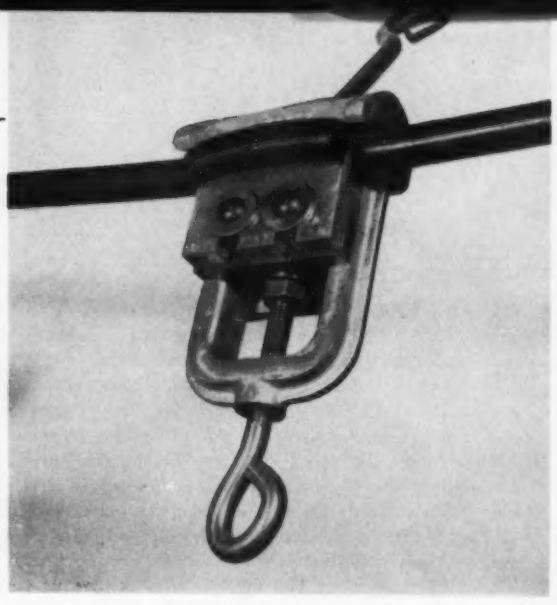
PHOTOELECTRIC LIGHTING CONTROLS

AN AFFILIATE OF SIGMA INSTRUMENTS, INC.

engineering talent concentrated on

New Equipment

Insulation Stripper . . .



. . . can remove linear polyethylene and other hard-to-remove insulations without nicking or scratching conductor. Used on conductors from No. 2 stranded to No. 4/0 ACSR, it removes 2.5-inch length of polyethylene, PVC, rubber or Neoprene insulation from 3/64 to 12/64 wall. One basic tool has interchangeable cutter blades for each conductor and insulation combination. Penn-Peeler is hooked over insulation, tightened by hand or hot stick, and rotated around conductor. Insulation chip falls away, exposing bare conductor. Built-in stop positions blade to prevent nicking conductor.

Penn-Union Electric Co, Erie, Pa.

Aerial Lift . . .

. . . has outer boom of Spiralloy insulation to provide safety in line work and tree trimming. Insulation is provided from the lift's knuckle to insulated basket. Electro-hydraulic controls have insulated linkage from knobs at basket to controls at knuckle. Maximum vertical reach is 40 ft. Maximum load for basket is 500 lb. Road clearance with booms in stowed position is 11 ft. Rotation is 420 deg. Vertical travel of lower boom is 90 deg, and of outer boom is 285 deg. Gross weight is 4,500 lb. Hydraulic power furnished by independent gasoline engine with air compressor. Tilt valves lock boom in position in event of hydraulic line failure. Lift equipment is mounted on chassis in back of truck cab, leaves clear body space for mounting of users body. Lift is adaptable for a truck chassis furnished by the manufacturer or purchaser.

Asplundh Chipper Co, 501 York Road, Jenkintown, Pa.

Ground Detector Alarm . . .

. . . has simple operation and can be easily wired into any system. Intended for use on a-c and d-c systems, 25 to 400 cps, one-, two-, or three-phase, it is available for voltages of 120, 240, and 480-600 v. In normal operation all three phase indicator lamps glow with equal intensity. When a ground occurs, the lamp on grounded phase

goes out, a red warning lamp flashes, and a relay acutates a horn or bell. When reset button is pushed, red light changes to a steady glow and remains that way until ground is cleared. This Brunt ground detector is 16x8x8 inches and weighs 14 lb.

The Brundee Co, Cranford, N. J.

Streetlight Control . . .

. . . has no tubes, transistors, or transformers and may be used for incandescent, mercury vapor, or fluorescent lighting fixtures. One basic unit handles all photoelectrically controlled lighting requirements when combined with auxiliary equipment. Unit does not require north light orientation and is inoperative during daytime. Operating level of the lamplighter can be adjusted from one f-c to six f-c for turn-on. Ratio of turn-off to turn-on level is

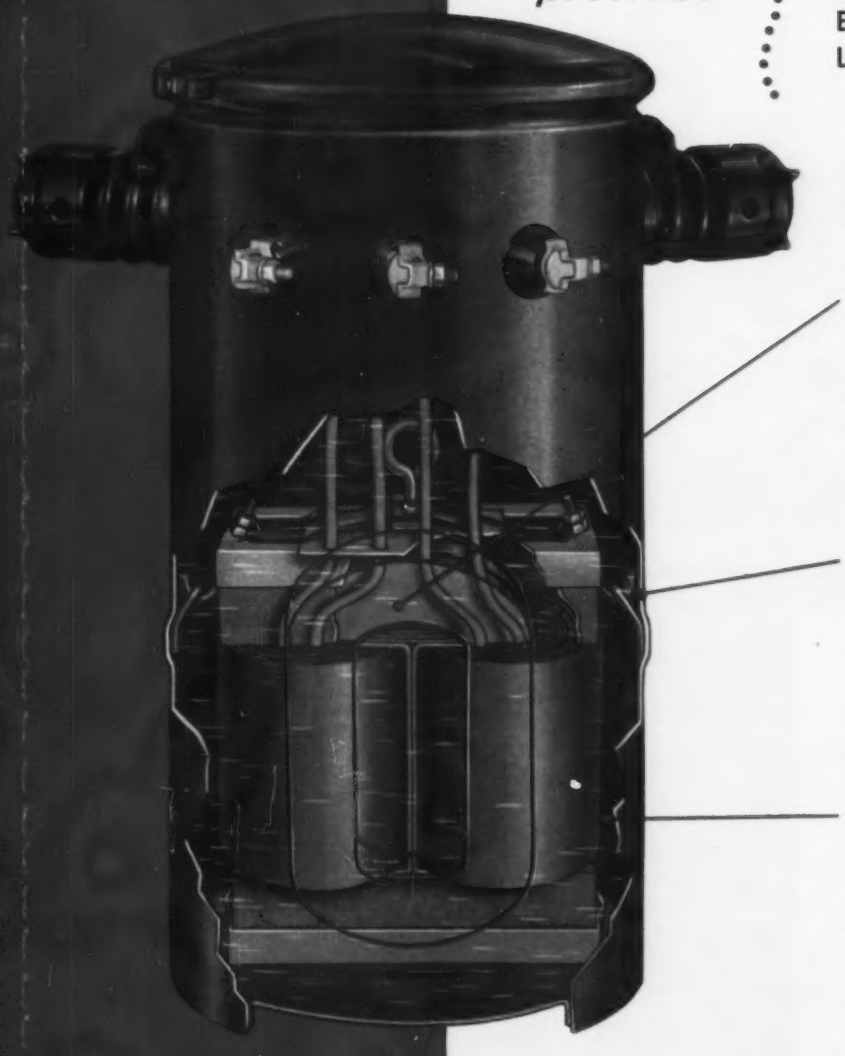
(*Continued on page* 108)

RT&E

engineering talent concentrated on transformer CORE development

provides

- **Lower Core Loss**
- **Uniform Performance Characteristics**
- **Quieter Operation**
- **Easier Repairability**
- **Lighter Weight**



The R T & E wound core represents the newest innovation in core construction in over 20 years. It is constructed of the finest grain-oriented steel available, formed into a compact core of single turn laminations with butted joints. It has set new standards for lower core losses, quietness of operation, uniformity of performance and easier repairability.

Two "J" bolts fasten the assembly securely to tank wall and exert a downward pull on the upper core clamp. The compressive force produced clamps the full-span coil blocks firmly against the coil sections for added short circuit strength.

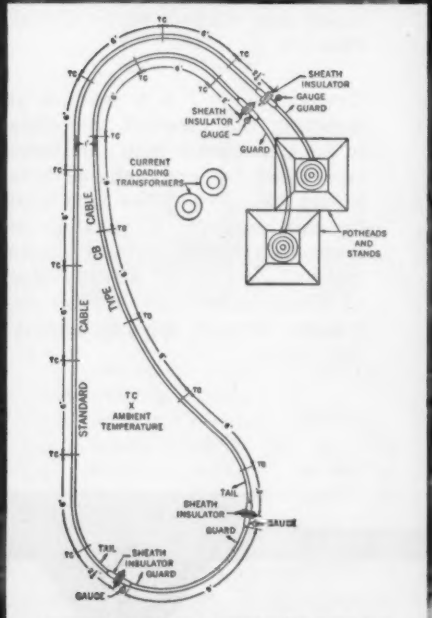
The unique R T & E method of fastening the core-coil assembly in the transformer tank eliminates the need for conventional side braces by utilizing the tank wall for this purpose. Elimination of these side braces exposes more coil surface to the oil, and provides an unobstructed path for oil circulation through the coil ventilating ducts.

ENGINEERING TALENT CONCENTRATED ON ONE IDEA — A BETTER TRANSFORMER

RT&E CORPORATION

WAUKESHA, WISCONSIN • PORTLAND, OREGON

Cyclic aging test on paper-lead power cable reveals –



RESEARCH LABORATORY SET-UP for cyclic aging test. Two single-conductor, 69kv shielded-type cables (one standard, one Anaconda Type CB) were spliced together to form a single cable. The cable was then subjected to cyclic aging for 404 daily load cycles. At end of test the two sections were studied—and revealed the results shown in chart at right.

Greater insulation stability...longer cable life with TYPE CB cable

Heat and electrical stress . . . heat and electrical stress—keep it up long enough and insulating oil in ordinary paper cable breaks down.

Anaconda Type CB* (Carbon Black) power cable is different. Special carbon-black tapes continually purify and stabilize the insulating oil over the life of the cable. These carbon-black tapes provide many advantages:

1. Oxidation products are removed.
2. Deterioration is reduced by continuous purification of the oil.
3. Conductor is shielded; strand discharges, and ionization discharges between insulation and sheath are eliminated; maximum stress is reduced more than 25 percent.
4. Destructive energy is reduced because the work function of carbon is much less than that of copper.
5. Surge currents are diminished.
6. Impulse strength is increased.
7. Dielectric strength and life are increased.

The over-all result is not only physical and electrical improvements, but also real economic gains for the user.

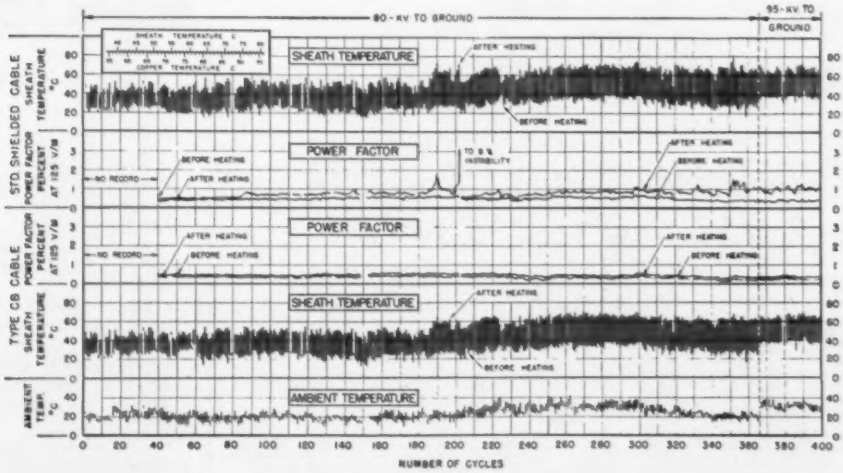
CYCLIC AGING TEST

For dramatic proof, no other test shows stability better than the cyclic aging tests.

The test shown here consisted of subjecting two single-conductor, 69kv shielded-type cables to cyclic aging for 404 daily load cycles. One cable was Type CB, the other a cable of standard construction. Both cables were still in operating condition at the end of the test. The standard cable, however, showed definite signs of aging. The Type CB cable showed no such signs.

WANT TO KNOW MORE? The Man from Anaconda will be glad to give you full information about Type CB cable. See him or write for Bulletin C-89. Anaconda Wire & Cable Co., 25 Broadway, New York 4, N. Y. 58081

*CB—Carbon Black (U. S. Patents 2,102,129; 2,405,853) Reg. U. S. Pat. Off.



CYCLIC AGING CHARACTERISTICS of 1/c, 650 Mcm, 69kv solid-type paper-insulated cable, standard construction compared to Type CB construction. Power factor readings during each cycle show low and constant values for Type CB cable—0.3 to 0.5 percent for both. The standard cable, with the same initial values, increased to over 1 percent at the end of the test. Power factor readings before and after heating during each cycle are also significant. At first, both cables show "after heating" values below those for "before heating." In the standard cable, the trend is reversed (69th cycle) and the "after heating" values are higher to the end. In the Type CB cable, the "after heating" values remain below throughout the test.

LOVE BETTER ELECTRICALLY

SEE THE MAN FROM **ANACONDA**®

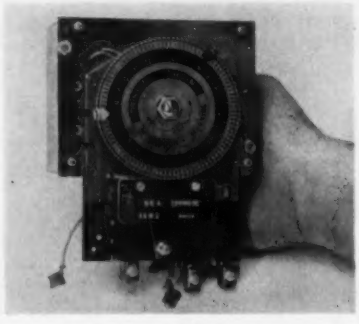
FOR **TYPE CB CABLE**

Streetlight Control . . .

less than two. Time delay is 4 sec. in relation to turn-off level. Relay load contacts are rated 10 amp. External sensitivity adjustment can be regulated with unit in service. **Acme Wire Co, 1235 Dixwell Ave, New Haven, Conn.**

Time Switch . . .

. . . with reserve power feature operates through outages up to 17 hr. It can be used for switching capacitor banks and is available in 55-amp model for street lighting. Unit obviates readjustment of time control after power is restored. Reserve action is provided by powerful, electrically wound spring. Special release exercises spring daily to prevent possibility of spring failing when needed. Spring is



rewound in 2 hr after 17-hr outage and faster for lesser outages. **Power Section, Tork Time Controls, Inc, Mount Vernon, N. Y.**

Reader Service

OCTOBER 13, 1958

For additional information on new products, supplies, and services in this issue, the Manufacturers Editor of Electrical World offers his facilities. Check items in which you are interested in list below:

NEW EQUIPMENT

Penn-Union ..... Stripper
Asplundh ..... Aerial Lift
Brundee ..... Ground Detector
Acme Wire .....Light Control
Tork ..... Time Switch
Royal McBee ..... Input-output
Thomas & Betts ..... Nylon Tie
Motorola ..... Radio
RFL ..... Telegraph Terminal
Berger ..... Portable Housing

OTHER

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Manufacturers Editor, Electrical World
330 W. 42nd St., New York 36, N.Y.

* **Note: Requests must be received within four weeks of publication date, accompanied by complete information specified. This service cannot be offered to readers in foreign countries or to competitive manufacturers.**

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TITLE_____

DEPT._____

COMPANY_____

ADDRESS_____

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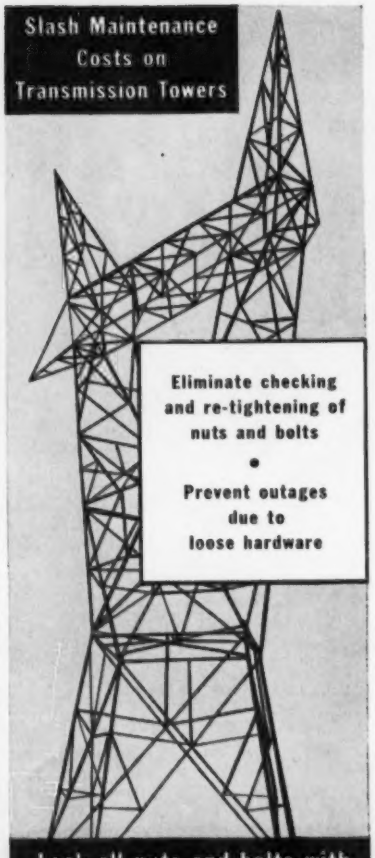
FOR:

Reference ..... ☐ Trial ..... ☐

Specs ..... ☐ Purchase ..... ☐

Slash Maintenance Costs on Transmission Towers



Eliminate checking and re-tightening of nuts and bolts

•

Prevent outages due to loose hardware

Lock all nuts and bolts with

PALNUT® LOCK NUTS

Applied in seconds— Stay tight for life!

PALNUT Lock Nuts are the lowest-cost, most reliable method of assuring permanently tight tower bolts, for these reasons:

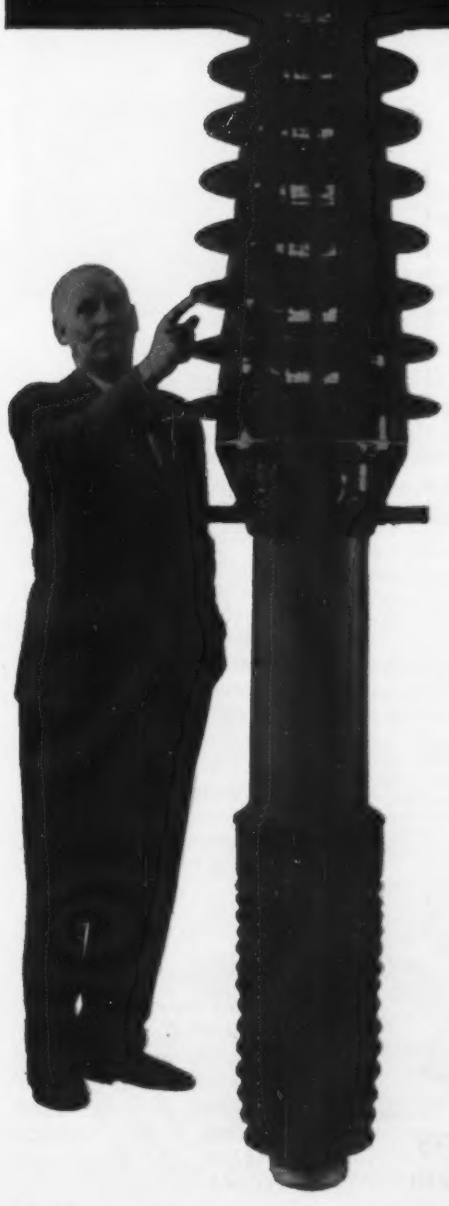
- **Vibration-proof.** Unfailing double-locking spring action holds assemblies to original tightness.
- **Easy, fast assembly.** Light in weight, easily carried, free-spinning, quickly locked with ¼ to ½ turn of linesmen's wrench.
- **Weatherproof.** Heavily galvanized to equal or exceed ASTM specs. Still perfect after 30 years' service on many towers.
- **Low cost.** PALNUTS cost a trifle more than one cent in average sizes.
- **Small space.** Need only 3 bolt threads.

Specify PALNUTS on all new towers —add them to existing towers. Send for Free Samples and data.

THE PALNUT COMPANY
51 Glen Road Mountainside, N. J.

Westinghouse Type "O"... only service-proved ASA bushing

Includes ratings 92 through 196kv



Westinghouse Type "O" bushings have an unmatched service record—demonstrated by over 300,000 bushing years of trouble-free service. Because new ASA dimensional requirements were achieved with no basic change in design, this is the only ASA bushing that is service-proved. Type "O" bushings offer plus values derived from over 50 years of Westinghouse leadership in condenser bushing design. Continuous research and development—made possible through PLOWBACK OF EARNINGS by Westinghouse—have produced these extra bushing features:

Exclusive, fully insulated potential device tap, unchanged dimensionally for 25 years, provides standard cable connection for any Westinghouse potential device. Does not have to be grounded —thus valuable bushing insulation is fully used at all times.

Extra interchangeability is achieved, in addition to the interchangeability with other manufacturers' bushings provided by ASA dimensions. Westinghouse ASA transformer bushings are designed to permit direct replacement of many older bushings. Westinghouse ASA circuit breaker bushings can be made interchangeable with flange and stud adapters.

Inventory savings are now possible: With Westinghouse ASA bushings as spares, bushing stocks can be reduced to a minimum. No adapters are required for most Westinghouse transformers.

Ask your Westinghouse representative about the ASA Type "O" bushings . . . or write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pa. J-70880

YOU CAN BE SURE...IF IT'S **Westinghouse**

The superiority of the Westinghouse one-piece weather casing of wet-process porcelain is pointed out by Bob Rung, Transformer Components Sales Manager. Loaded in compression only, it provides the Type "O" bushing with exceptional mechanical strength.

Repeated testing of Type "O" bushings as part of high-voltage power circuit breaker development program proves the superior mechanical and electrical strength of these bushings has been maintained in achieving interchangeability, as provided by new ASA standards.

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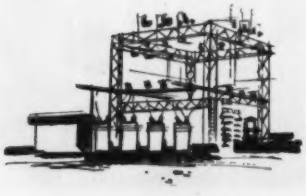
SAVES MATERIAL — SPEEDS ERECTION REDUCES COST . . . Now Erecticon substations can offer you even greater savings. The new Modified Erecticon, fabricated exclusively by Schuler, costs less and erects faster—for substantial savings. It's the same pre-engineered system tested and proved by leading utilities, improved by Schuler ingenuity to effect even greater cost savings for utility engineering staffs and erection crews. Schuler-built Erecticon stations are the fastest, most economical to erect, yet they are the highest quality obtainable. It will be worth your while to investigate Modified Erecticon before you build another substation. Call our Engineering Department, or write for our new Modified Erecticon Bulletin. No obligation, of course.

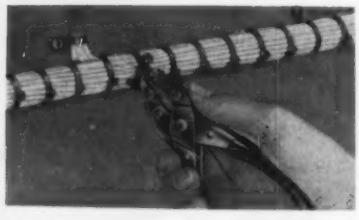
Modified Erecticon is ideally suited for the packaged plan of purchasing substations. If you prefer packaged substations, ask your switch gear supplier to specify Schuler's Modified Erecticon.



the charles e.
schuler
engineering company
109 Cambria St. - Newark, Ohio

Input-Output System . . .

. . . for LPG-30 computer is an auxiliary unit for applications where large amounts of data must be processed. It is available either as a combination high speed punched tape reader and punch or as a reader alone. Model 341 Reader operates on photo-electric effect and reads punched tape at rate or 200 characters per sec. Model 342 incoporates both reader and punch in same unit. Punch speed is 20 characters per sec. Tapes are compatible with paper tape typewriter furnished as standard equipment.
Royal McBee Corp, Data Processing Div, Port Chester, N. Y.



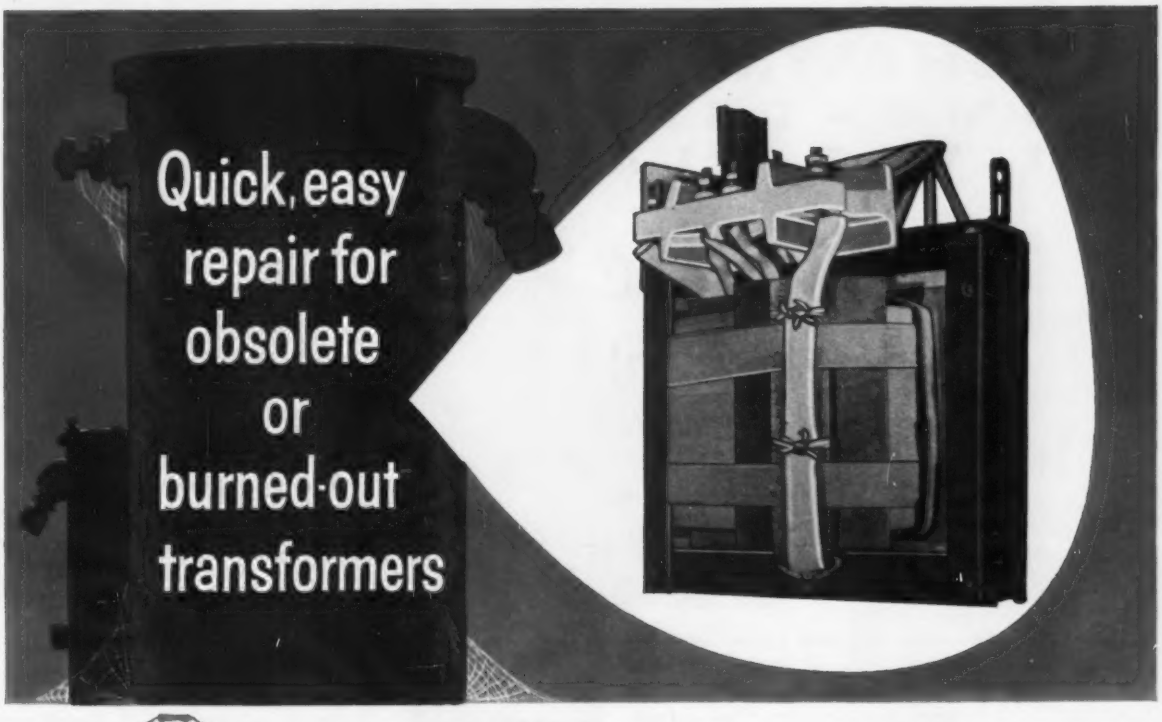
Nylon Tie . . .

. . . speeds binding of harnesses, bundles, or groups of wires. These Ty-Rap cable ties make up tightly without damage to wire insulation and remain permanently secure. Molded of 101 Zytel Nylon, they can accommodate bundles from $\frac{1}{16}$ through 1¾ in. in diameter. They will not support combustion and are available in seven colors for color coding applications. After tie is slipped under bundle, knurled tip is pulled through hub on opposite end. Installing tool automatically cuts Ty-Rap to proper length and locks it in place. Self-clinching model, with metal teeth in hub is also available.
Thomas & Betts Co, 36 Butler St, Elizabeth, N. J.

Pocket Radios . . .

. . . for personal communication include receiver and transmitter. The 46 oz. transmitter, measuring 8x4x1.5 inches, has 1.25-w output in 24-54 Mc band and 1.0-w output in 144-174 Mc band. Receiver measures 6x2.5x1.125 inches and

(*Continued on page* 112)



Wagner Form W Core and Coil Replacement Assemblies come *ready to install in any make of tank!*

Here's a money-saving way to salvage old distribution transformers ear-marked for the scrap heap. With Wagner Form W Core and Coil Replacement Assemblies, obsolete or burned-out transformers can quickly and easily be made as good as new again . . . *and uprated at the same time.* These packaged replacement core and coil assemblies are factory-new elements, exactly like those used in new Wagner Transformers. Assemblies come ready for use . . . fully tested . . . thoroughly dried. They are protected in a sealed container filled with Wagner inhibited transformer oil, which you can also use in your transformer. Assemblies are complete with terminal board or tap changer, with leads ready to install in your tank. Each assembly has a new serial number and nameplate. Available in ratings from 3 through 167 kva.

WAGNER BUSHING ASSEMBLIES

LOW VOLTAGE BUSHING ASSEMBLY

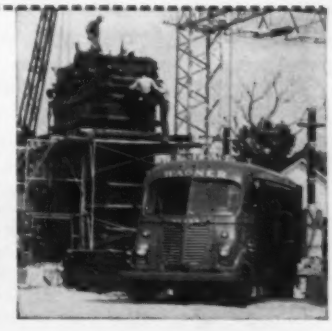
Ready to install—includes porcelain bushing, gasket, solderless connector-type terminal and clamping device.

HIGH VOLTAGE BUSHING ASSEMBLIES

Available in cover-mounted or tank wall-mounted types to meet a wide range of requirements. Gasket, solderless connector-type terminal and clamping devices are included—fuses can be furnished when specified.

WAGNER FIELD REPAIR SERVICE FOR SUBSTATION TRANSFORMERS

Wagner's Transformer Service Trucks—completely equipped for field repairs—each with the services of an expert—are available on schedule in most localities. The cost of this exclusive Wagner service is nominal—write for information.



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BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

Wagner Electric Corporation
6456 Plymouth Ave., St. Louis 14, Mo., U.S.A.

WR58-4

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES • AUTOMOTIVE BRAKE SYSTEMS—AIR AND HYDRAULIC

SHAWMUT'S TIME-TESTED SILVER-PLATED

Tri-onic

(Dual-Element)

The General Purpose Fuse

*Interrupting Capacity 25,000 Amps. A.C.

KEEPS MOTOR CIRCUITS SAFE

This is the first low voltage fuse with a published interrupting capacity of 25,000 Amps. (15,000 Amps. more than required by U.L. Standard for fuses.) For real protection use it in place of all ordinary types of fuses.

TRI-ON(IC)* GIVES 3-WAY PROTECTION

1. **HIGHER INTERRUPTING CAPACITY.** 25,000 A. @ 250 V & 600 V. Handles short-circuits 2½ times larger than ordinary fuses. Expands fuse application into 25,000 Amp. zone. Use it on bus plug-in duct, bus-ways, feeders, motor control panels, branch circuits.
2. **LONG TIME-DELAY.** Safely starts heavily loaded motors without blowing. Prevents circuit "outage" caused by heavy motor-starting currents or load swings. Provides "matched" protection for your motors.
3. **COOLER OPERATION.** Runs cool because of silver-plating and low I^2R losses throughout. Opens at 286° F, or 500° lower than ordinary zinc links. Ideal for distribution and panel boards, motor branch circuits, knife and enclosed switches.

* U.S. Patent Nos. 2,111,749 – 2,300,620 2,321,711

Insist on TRI-ONIC.
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Tri-onic – "Awake At The Switch"

THE CHASE-SHAWMUT CO.

374 MERRIMAC STREET • NEWBURYPORT, MASSACHUSETTS

Subsidiary of I-T-E CIRCUIT BREAKER CO., Philadelphia, Pennsylvania

Est. 1893

Amp-trap® Tri-onic® C-O-T® TRIONIC® O-T

Pocket Radios . . .

(*Continued from page* 110)

has 100 milliwatt output into built-in speaker. Receiver uses either rechargeable nickel-cadmium battery, providing up to 20 hr operation, or replaceable mercury cells, good for 120 to 200 hr. Receiver weight is 10.5 to 12 oz. Present receiver pricks up all signals on system frequency. Later model will have selective signalling feature.
Motorola, Inc, Communications & Industrial Electronics Div, 4501 W. Augusta Blvd, Chicago 51, Ill.

Telegraph Terminal . . .

. . . for telemetering and control applications is transistorized, audio frequency shift unit capable of transmitting at speeds to 250 wpm. Eighteen 100-wpm channels are available from 425 to 3315 cps and six wide-band, 200-wpm channels from 1615 to 3315 cps. Featuring modular construction, it transmits coded data over lines, cable, microwave, and carrier circuits. Components of this Model 1220 can be arranged for dual transmitter, dual receiver, or transceiver on single 19.5x5.25-inch rack.
Radio Frequency Laboratories, Inc, Powerville Rd, Boonton Township, N. J.

Portable Housing Unit . . .

. . . with pneumatic walls inflates in 5 minutes to form rigid, self-supporting structure. Unit does not need constant supply of air. Once unit is erected, air pump can be

(*Continued on page* 114)

Tube mill operator here keeps close watch as he adjusts weld heat on control console.

Contractors find:

CIRTUBE* EMT maintains uniform high quality

KNOWING that the EMT you use is always of the same high quality—from tube to tube, bundle to bundle, and month to month—is one sure way to help guarantee better electrical jobs at lower installation costs.

CIRTUBE EMT is like that. Made in a brand new plant, with ultra modern equipment, the latest techniques, and the most stringent quality control measures that experienced engineers can devise, CIRTUBE EMT has already acquired a reputation for unsurpassed uniform quality and workability.

Uniform, high quality is only one of many reasons why CIRTUBE EMT helps get better, more profitable wiring jobs.

Why don't *you* try CIRTUBE EMT on your next job — you'll like working with it. Now at your Circle wholesaler's. *Trade Mark

CIRCLE WIRE & CABLE
a subsidiary of
CERRO DE PASCO CORPORATION

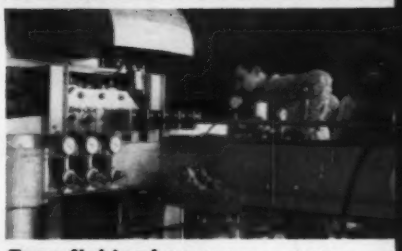
PLANTS: Maspeth and Hicksville, N. Y. **SALES OFFICES & WAREHOUSES:** In all principal cities

RUBBER COVERED WIRES & CABLES • VARNISHED CAMBRIC CABLES • PLASTIC INSULATED CABLES
NEOPRENE SHEATHED CABLES • "CIRTUBE" EMT

CIRTUBE EMT *Ask for it!*

Proper steel plus! The best cold rolled steel plus the right handling give CIRTUBE EMT its natural bendability.

Split-free, bead-free! Induction welded CIRTUBE EMT, left, proves stronger than ordinary EMT, provides easier fishing.



Easy fishing! A baked-on protective coating gives CIRTUBE EMT a built in lubrication for easier wire pulling.

Lifetime exterior finish! Hard galvanized finish for durability; polished satin lustre for lasting good looks.

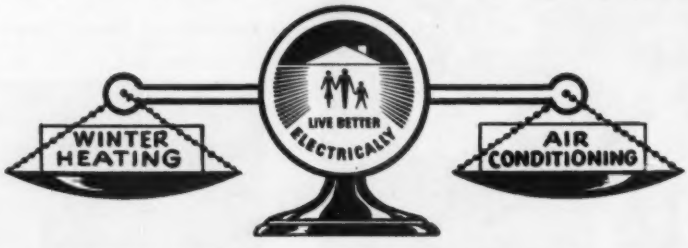
Tight, easily handled bundles! Bright, orange tapes hold CIRTUBE EMT securely for easy handling on and off the job.

Fast, friendly service! Well-known Circle service through a nation-wide network of well stocked nearby warehouses.

BUILD YOUR WINTER LOAD
with ELECTROMODE

ELECTROMODE All-Electric HEATERS

The perfect BALANCE for your Summer Air Conditioning Demands



EVERYWHERE, *more and more people are* LIVING BETTER ELECTRICALLY

and Electromode is ready with the World's *Safest* and most complete line of All-Electric Heaters, to help utilities stabilize their loads on a year 'round basis.

More than 100 Models, specifically designed for the needs of

HOME • FARM • INDUSTRY

ELECTROMODE
BASEBOARD ELECTRIC HEATERS

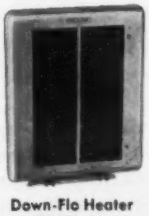
WALL-TYPE FAN-CIRCULATING HEATERS

For All Size Rooms

Bathroom Heaters

Also made in Portable models, modern designs, and capacities for large and small rooms.

Other Electromode HOME Heaters: Radiant Cable Heat and Radiant Convection Panel Heaters



Down-Flo Heater for Big Rooms

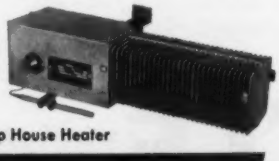
Suspension-Type Heater

FOR INDUSTRY

Electromode Heaters are made in Suspension-Type, and Combination Portable and Suspension Heaters, as well as Explosion-Proof Heaters, specifically designed and approved for use in hazardous areas.

ALL AROUND THE FARM

Milk House Heater



Pump House Heater

Why Electromode is SAFEST!

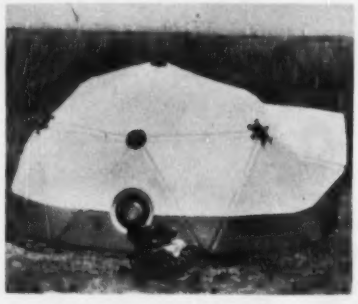
because only Electromode has the Safety Grid, a completely sealed-in cast-aluminum heating element. No exposed hot wires or glowing coils. No danger of fire, shock or burn. Automatic safety switch prevents overheating.

ELECTROMODE
Division Of
COMMERCIAL CONTROLS CORPORATION

Get Complete Information From
Dept. EW-108 570 Culver Road
Rochester 3, New York

Portable Housing Unit . . .

(*Continued from page* 112)



disconnected. Known as a Geodome, it withstands winds up to 120 mph and snow loads to 30 lb per sq ft. Units with 16.5 or 48-ft diameter can be used for field work; smaller units are available for work in manholes and vaults. Absence of poles, ribs, or other supports makes all interior space usable. Deflated unit can be folded to fit into jeep or small station wagon.
Berger Brothers Co, New Haven, Conn.

More New Products

Portable, all-purpose **winch** powered by 6- or 12-v battery lifts 1,250 lb on single line and 2,500 lb on double line; pulls 2,500 lb and 5,000 lb. MyTe winch has 32 rpm drum speed. Drum capacity is 150 ft of ¼-in. cable—City Engineering Co, Inc, 3547 Massachusetts Ave., Indianapolis, Ind.

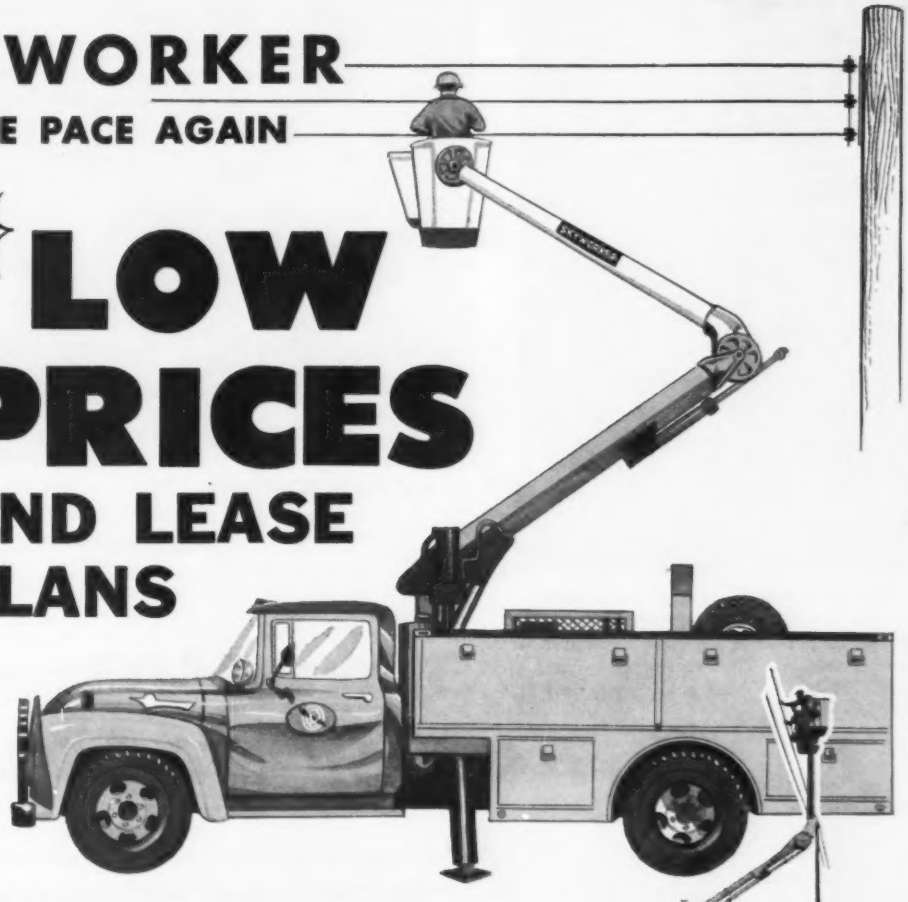
Miniature **indicating, recording and controlling instruments** have optional plastic or metal doors. Plastic provide superior visibility and are gasketed to keep out dust, dirt and harmful vapors.—Fischer & Power Co, 756 Jacksonville Rd, Hatboro, Pa.

Recessed **incandescent lighting element** provides 11-$\frac{5}{16}$-in. sq lens area with 12 in. sq opening. Uni-Frame 200 handles 100, 150, 200-w lamps; Model 300 takes 300-w medium base lamps. Pyrex lens features bifocal prism design. Unit is designed to replace a 12-in. sq ceiling tile and can be adjusted to compensate for ceiling materials of various thickness. — Day-Brite Lighting Inc., 626 N. Broadway, St. Louis 15, Mo.

SKYWORKER
SETS THE PACE AGAIN

New

LOW PRICES AND LEASE PLANS



Skyworker hydraulic aerial lifts are used by leading utilities to cut the costs of line work as much as 50%. Skyworker now sells the utility Model 1035A for the remarkably low price of $5,333. Wide acceptance makes possible similar reductions for other new and improved Skyworker models.

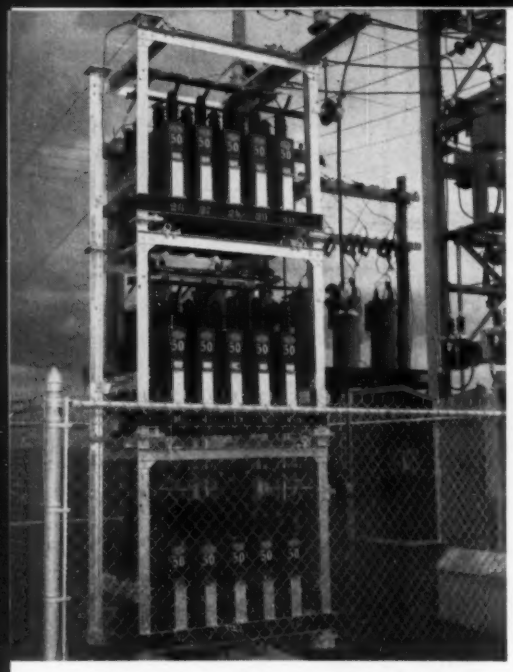
Skyworker Model 1035A provides any desired working height above ground up to 41 feet; horizontal rotation of the mounting turret is 400° — 40° past full circle. Whether it's a mid-span job or work at the pole, this versatile Skyworker sets new records for time required, while substantially improving safety.

Skyworker Lease Plans are available for one, two or three years. Any plan saves capital investment, gives you the opportunity to accumulate experience on your toughest application and to prove *your* savings before purchase.

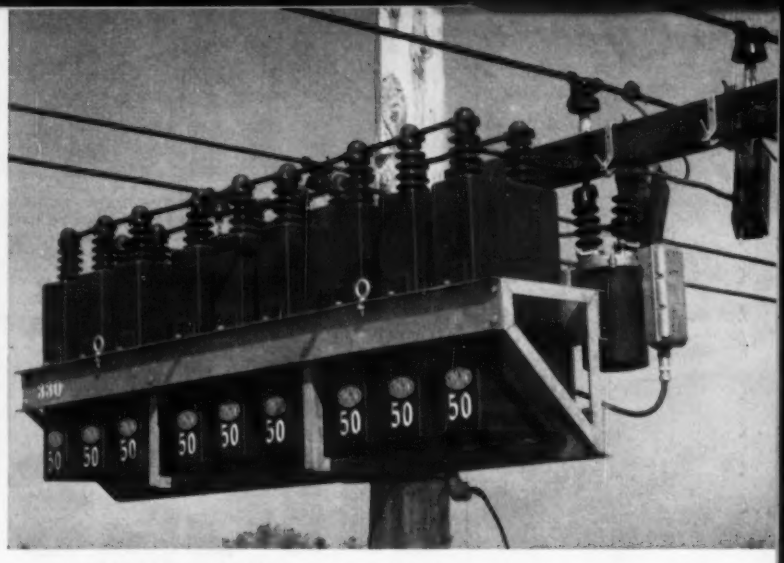
Dual work platforms make Skyworker Model 4033 ideal when the job requires two men aloft. Aerial lift price — $6,290.

The Skyworker Model 1030 is widely used for group replacement of lights, and can be used for line work. Aerial lift price — $4,950.

EMHART MANUFACTURING COMPANY
SKYWORKER DIVISION
762 Windsor Street
Hartford 1, Conn.



OPEN-TYPE EQUIPMENTS... Singlephase stacking units can be arranged in combination to give any desired bank kvar at subtransmission and transmission voltages. Three phase open-type racks are available for small bank installations at substations.



AUTOVAR EQUIPMENTS... These factory-assembled, pre-wired pole-type equipments permit fast, easy, and low cost capacitor installation on distribution circuits—available in multi-row, in-line, cluster mount, or designs to user specications.

SANGAMO can fill all the *MOST COMPLETE*

Whether you install power factor improvement capacitors in banked high voltage units or as individual low voltage units, you can make Sangamo your primary source of supply for all your capacitor needs.

Sangamo offers the most extensive line of primary and secondary capacitors, equipments, and controls available from any manufacturer.

For more information ask your Sangamo Representative or write for Bulletins 1110, 1130 and 1131.

INDIVIDUAL UNITS... Sangamo 15, 25 and 50 kvar primary power capacitors are built to utility engineers' specifications to assure "performance stability." They are stocked in all NEMA voltage ratings, and special ratings can be readily supplied.

HOUSED CAPACITOR EQUIPMENTS... Engineered for safety and appearance, Sangamo housed capacitor equipments provide a compact installation. They can be supplied with automatic control, and with or without circuit breakers.

UNDERGROUND EQUIPMENTS...These enclosed submersible primary capacitors provide kvars in locations where overhead pole space is not available. Capacitor units are completely sealed to guard against mosture or submersion in underground vaults.

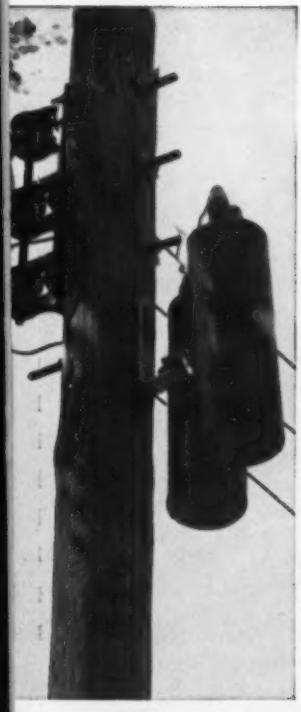
Type S Plug-in 2 kvar unit, for meter socket mounting.

Type N Nipple connected 3 kvar unit, for three phase service.

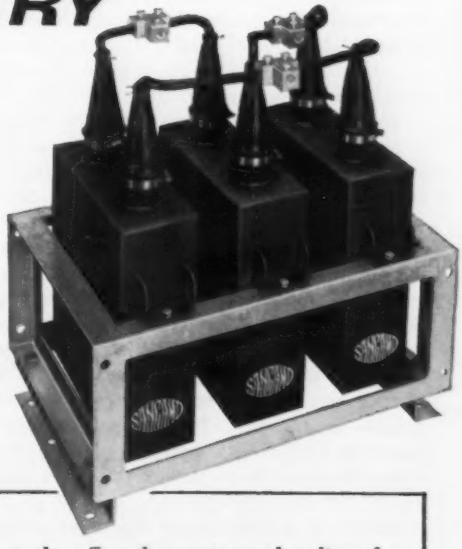
Type N Nipple connected 1 kvar unit, for adjacent mounting.

SECOVAR SECONDARY CAPACITORS... Only Sangamo can offer these 240 volt capacitors for installation at the customer's service to give maximum system benefits all down the line. They give the advantages of low first cost—quick and easy installation—installation off the pole. Secovar capacitors are available in three types with optional thermostatic switch for automatic operation.

your capacitor needs from *LINE IN THE INDUSTRY*



SECONDARY CAPACITORS... Pole-type secondary capacitors for mounting directly to pole or cross arm. Indicating type fuses are available.



SUBMERSIBLE SECONDARY CAPACITORS ... These secondary capacitors are completely sealed against moisture. Ideal for low voltage underground network installations. Available in factory-assembled equipments to fit your needs.

Sangamo also offers the most complete line of automatic controls for your capacitor installations. Whether you wish to switch capacitors as a function of voltage, current, watts, vars, temperature, time—or combinations of these—Sangamo can supply a control for your application. No other manufacturer offers this variety.

PC58-5

LIVE BETTER ELECTRICALLY

SANGAMO Electric Company

SPRINGFIELD, ILLINOIS

MAJOR APPLIANCES are repaired on the second floor on assembly line with four rows of outlets and connections

SMALL APPLIANCES repair and associated parts inventory are also located on the second floor

Tampa Electric Has Appliance Service Center

VIRGIL S. PRICE, Advertising Manager, Tampa Electric Co, Tampa, Fla.

A new appliance service center has been opened by Tampa Electric Co to provide better service for its customers. The modern 1½-story facility incorporates many features that have improved the efficiency of servicing small and major appliances and commercial cooking equipment, compared with the former center.

This non-merchandising company believes it has an obligation to its customers, as well as itself, to keep appliances operating. This makes for better acceptance of electrical living and keeps the meters turning.

The company does not advertise servicing in competition with local dealers. However, lack of advertising has not decreased the amount of work handled. The combination of customers who look to the utility to maintain appliances, plus the resulting word-of-mouth advertising keeps the 45-man service center busy.

Last year, the facilities handled 26,557 major appliance service calls and repaired 13,486 small appliances. Tampa Electric does not service radio, TV, and hi-fi sets, clocks, and air conditioners. This cuts down the parts inventory and provides ample work for dealer service organizations.

On the first floor of the center are offices, reception area, parts inventory for major appliances, facilities for records and repaired appliances, truck docks, and storage for major appliance "loaners." On the second floor are the repair rooms for major and small appliances and the parts inventory for small appliances.

Before appliances are repaired, customers are given a cost estimate. For small appliances, the charge is $2.80 per hour plus parts at catalog list price, cash and carry. On major appliances, the minimum charge for a service call is $2.00, up to the first 30 min of labor, and $2.80 per hour after that. If the appliance must be repaired in the shop, the call charge is picked up in shop labor. Cost of parts is also made at catalog list. For repairs above $20, the customer can arrange to pay on a 30-day charge or contract basis.

Tampa Electric has 17 service trucks and 16 outside servicemen. One truck is used as a spare for emergency calls. Each truck carries from $800 to $1,200 in parts so most repairs can be made on the spot. Two other trucks pick up major appliances that must be brought in for shop repairs. They also carry loaner refrigerators and ranges to be used while the customers' units are being repaired.

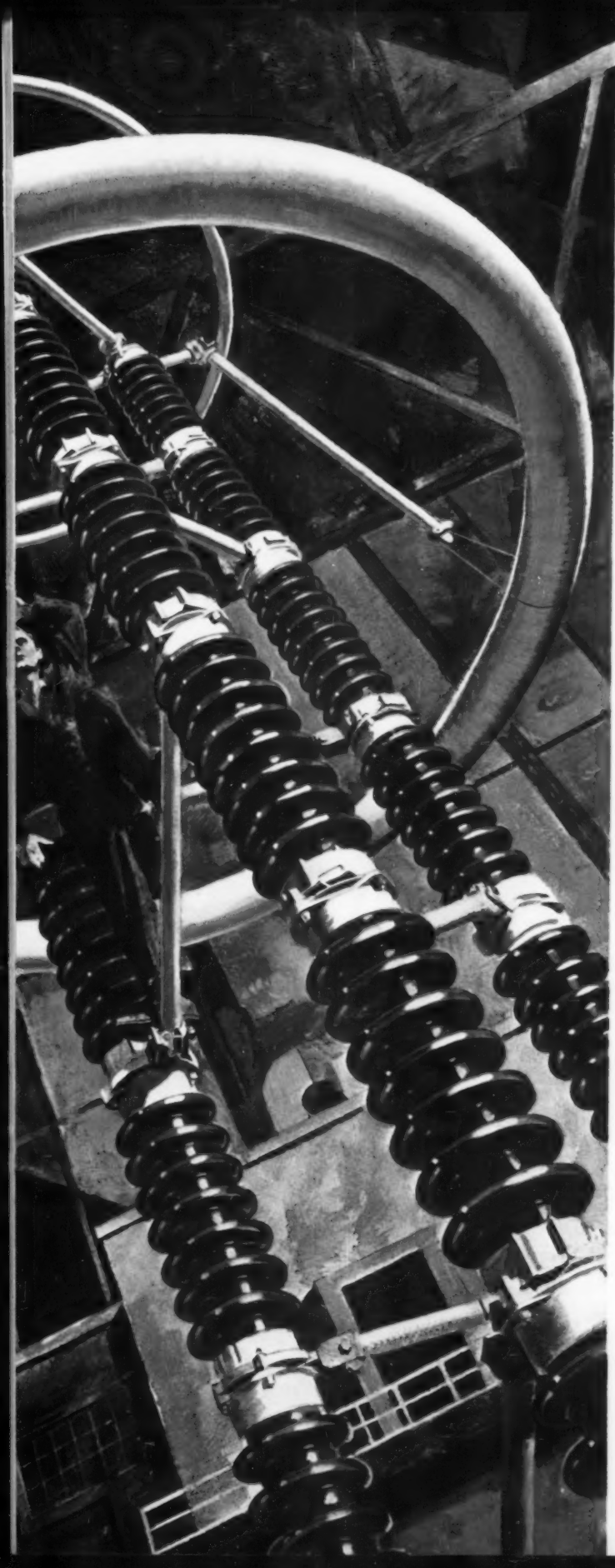
Complete inventory and repair records are kept. By comparing the inventory records for each part with the maximum and minimum inventory established from experience, employees can determine exactly when to re-order parts in short supply. Records show whether a part is on the shelf or checked out to a serviceman. This system also enables personnel to determine quickly the status of a customer's repair order.

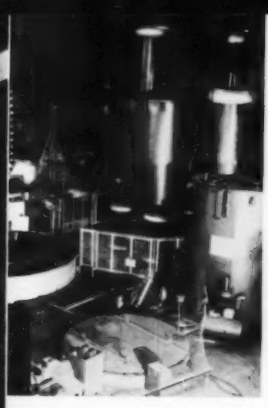
A recent innovation is a cross-filing system by streets and house number on the repair history of equipment. This file permits the company to tell a customer quickly when the last repair was made and the cost. Owners of rental property have found this information very helpful in determining when to replace equipment.

All company service personnel are well trained. All attend manufacturer service schools and receive on-the-job training in new products and service techniques.

One of the biggest problems is storage of unclaimed small appliances. Although the customer receives a tag stating that unclaimed merchandise will be sold or destroyed after 30 days, the company usually keeps these units for at least 2 years. Customers are notified by post card and phone.

In designing the service center, Tampa Electric practiced what it preaches by installing year-round air conditioning. Offices, reception area, and small appliance repair shop are heated and cooled by two 7½-ton and one 3-ton heat pumps. Other parts of the center are heated, when necessary, by portable electric heaters.





Westinghouse High Voltage Laboratory at Trafford, Pa., where test voltages range to 1,000,000 volts, continuous 60 cycle, and to 3,000,000 volts surge.

3 million volts subject apparatus to nature's roughest test

PLOWBACK OF EARNINGS CREATES HIGH VOLTAGE LABORATORY

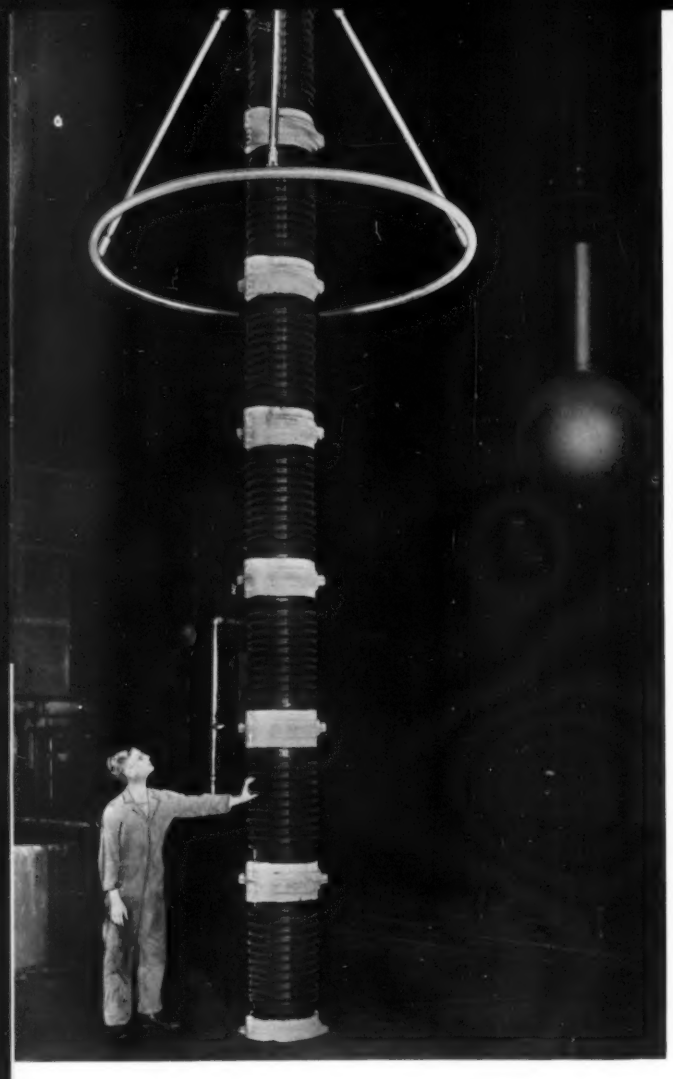
At the Westinghouse Trafford, Pa. plant, the most complete high voltage testing facilities in the industry are constantly at work proving and improving apparatus for the electric utility industry. Here, specially designed equipment reproduces the tremendous surges of natural lightning—impossible in conventional high power laboratories and research facilities. On the left, for instance, is shown a 350-kv experimental arrester . . . exhaustive testing of this unit led to development of the modern Westinghouse SVS self-supporting, folded-pole arrester pictured on the reverse side of this page.

Insulation strength of all types of equipment is predetermined at the laboratory and steps are taken to prevent failure in actual use. Hence, all Westinghouse apparatus is thoroughly proved at design stage. These facilities are used also to investigate corona and corona loss, radio and television influence, effects of weathering, and produce a host of technological advances.

Through such reinvestment of earnings into research, Westinghouse is providing the electric utility industry with equipment of the highest material and functional quality —equipment which assures safe, economical, lasting service and satisfied customers.

YOU CAN BE **SURE**... IF IT'S

Westinghouse



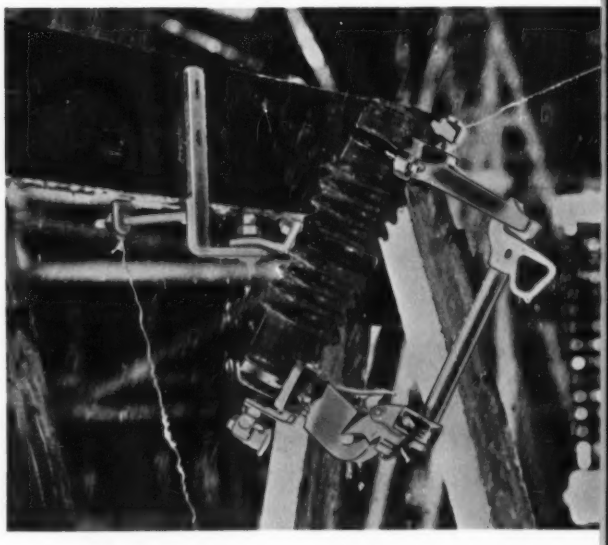
Man-made lightning bolts prove effectiveness of "condensed" arrester design

Westinghouse research and testing methods have put station protection years ahead of requirements. The problems of decreasing space allowances and greatly expanded operations have made it necessary to pack more protection into smaller areas. Westinghouse has reduced arrester height as much as 45% by physically paralleling the elements while keeping them in series electrically. The arresters are self-supporting and have up to 300,000 pound/inch cantilever strength.

These developments and facilities are but a part of many which are continuously at work, finding better ways to make better equipment economically for the electric utility industry. For information, call your Westinghouse representative, or write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania.

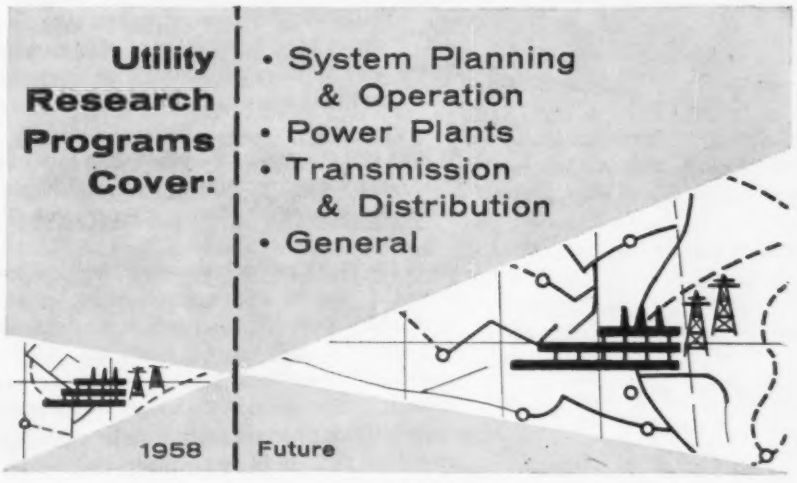
Exhaustive testing guarantees maximum protection for costly equipment

Tests like this voltage-withstand trial, using a 30,000-volt circuit under conditions simulating heavy rain, subject cutout insulation to the severest service stresses. With such thorough testing, Westinghouse protective devices assure you of the greatest possible protection from flashover at contacts or sheds. JI-97232-2



YOU CAN BE SURE... IF IT'S Westinghouse

Report on Research

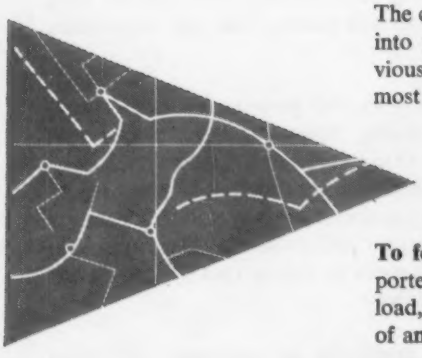


Utilities Push 968 Research Jobs

Electric utilities do a surprisingly large amount of research. That's the conclusion drawn from a two-year study just completed by Edison Electric Institute's Research Projects Committee. The committee's survey, directed by Consultant Howard P. Seelye, makes it clear that utility research is more than just cooperation with electrical manufacturers. Over and above the massive volume of research and development work carried on by manufacturers, the survey turned up no less than 968 separate projects, covering 763 subjects.

Subjects of research range from cable splicing to dam construction, and from weather forecasting to woodpeckers. Many are duplicated by several utilities. The EEI study provides a clear indication of the value of a clearing house to make individual companies' activities known to other members of the industry, gaining the benefit of pooled resources and wider application of results.

The committee used a broad definition of research: "Any organized investigation into new materials, new equipment, new processes or new methods not previously used, both in engineering, and also in other fields." Here are a few of the most interesting projects that fell under that definition:



System Planning and Operation

To forecast what load will be like, tomorrow or ten years hence, utilities reported research projects devoted to effect of temperature and sunlight on system load, use of radar to warn of approaching ice and thunderstorms, correlation of annual tree growth with precipitation and river-flow cycles.

To find the optimum size of generators to carry load reliably for any system, several studies of generating reliability by statistical and probability methods

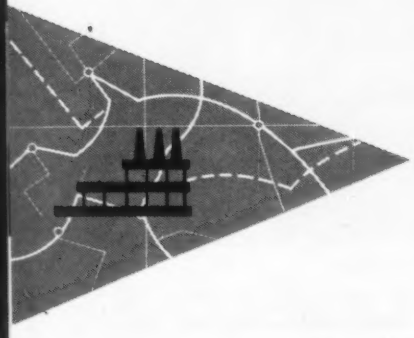
are underway. Another research study seeks to simplify ways of making economic comparisons and arriving at the optimum size of generators for any system.

To improve the means of maintaining the best distribution of system load on diverse generating units, eleven power companies have reported research programs moving along different paths. Targets range from simplified formulas or diagrams to automatic computers and even automatic control of the load allocation. Projects have been devoted also to emergency operation, specifically to coping with "cold inrush" current encountered in picking up a dead area load, and to exploring ways to automatically shed system load in emergencies.

At least two companies are attempting to set up basic service standards for continuity and voltage variations, which will help them to arrive at the best practical answer to the question: "What is good service?"

There are many projects studying electrical and physical phenomena and characteristics. Among them are two studies of 345-kv line characteristics including radio interference. Another investigates characteristics of lines up to 500 kv at high altitudes. Still another deals with high-altitude corona and radio interference of 115-kv lines. Ten companies are working on the lightning problem—frequency, mechanism of flashovers, use of shielding on distribution lines, impulse characteristics of wood and of aerial cable. Other interesting projects reported are studies of noise in power plants and transformer stations, and of vibration in turbine-generator foundations.

Two utilities seek simpler voltage-drop calculations, and a number are studying conductor characteristics, including ac resistance and impedance of cables, temperature rise and thermal rating of overhead lines, conductor vibration, galloping, and burn-down. Two investigate structural and reinforcing steel in structures acting as electrical conductors. Ten projects cover thermal characteristics of soils.



Power Plants

Ninety companies are participating in the atomic power program, with three plants in operation to show for it. Four more projects are under construction, and definite commitments have been made on two others. The gas turbine is the subject of three research projects. Another involves a coal-burning gas turbine and a gasifyer for use in connection with a gas turbine.

Hydro power claims the focus of three projects on cloud seeding, and three on evaporation from reservoirs. Aerial photography in snow surveys is being studied, and two projects aim at forecasting and automatically reporting river flow. Two projects strive for improvements in dam construction, and three others cover flumes and canals.

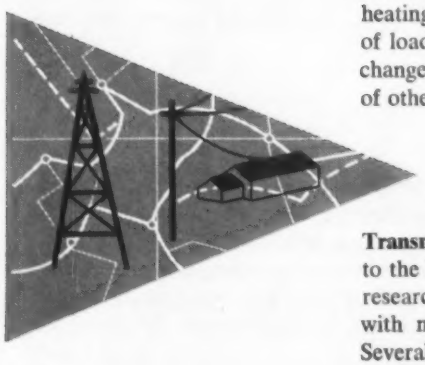
But steam plants draw the most attention, with 265 projects reported. Thirty-seven of these fall generally under the heading "boiler-water treatment," with an eye to reducing corrosion and deposits. One company has undertaken a basic investigation of the phenomenon of boiling. Six perform research on supercritical steam. EEI itself is participating in a project headed by ASME for the extension of steam tables to higher temperatures and pressures. There are eight projects on steam power piping. And one seeks to reduce cool-off and restart time of boilers by pumping water through them.

Four projects deal with stack design; six investigate air preheaters; and seven seek better dispersion of stack gases without undue air pollution. Three seek to reduce the amount of sulphur compounds in stack gas, and one looks at the

chances of extracting germanium from stack gas in economic quantities. Twenty companies are pursuing the possible economic uses of fly ash—as an admixture in concrete, a soil stabilizer in road building, a filler in bituminous paving materials, and some other lesser uses.

The condensing system is also being studied. Four projects look at aluminum condenser tubing. Three concern themselves with interference to plant operation by fish, debris, or algae in the cooling-water intake. Another is studying the deterioration of wood cooling towers due to fungus attack.

Most research on turbine generators is done by manufacturers, but utilities are investigating how to improve their operation and maintenance. Six research projects are directed at development of quick starting, with consideration given to operating procedures, instrumentation, and minimizing thermal stresses. Two look into pre-warming to minimize starting stress, and one investigates the heating of bolts and flanges to permit accelerated loading. Another studies effect of load changes on large generating units and development of the best rate of change. Heat rate and thermal efficiency is the subject of six studies, and a number of others are devoted to possible use of low-grade fuels.



Transmission and Distribution

Transmission and distribution account for 351 utility research projects reported to the EEI committee. Underground installations have a prominent place in the research efforts of many utilities. A project of EEI and AEIC in cooperation with manufacturers pertains to cable materials and designs up to 345 kv. Several utilities are researching high-pressure gas-filled cables for 138 kv, including application and control of gas, effect of severe load cycles on compound drainage and ionization potentials, possible use of gases other than nitrogen, terminal bushing design, and location of leaks. In lower-voltage cables, eleven projects deal with plastic, synthetic, and rubber-like insulations, joints, terminals, and entrances. Seven companies are studying the use of aluminum conductor for cables and aluminum cable sheaths. Others deal with arc-proofing, corrosion prevention, and insulation damage due to severe faults.

Explosions in underground transformer vaults occupy the attention of one utility, striving to understand and prevent them. Another company is looking for the relationship between size of manholes and cable life. A third is studying protective coatings for underground transformers.

On the list of projects devoted to station equipment, power transformers occupy an important place. One company is developing determinants for the condition of transformer insulation, and three projects are devoted to ascertaining the maximum load capability and economic loading of power transformers. Another project has originated a method of testing for internal faults, such as shorted turns, without going into the transformer. There are also studies on transformer oil deterioration and resistance measurements of circuit breaker contacts, made without opening the breaker.

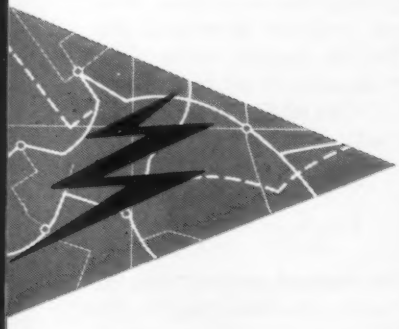
Work to improve overhead line structures includes several projects investigating tubular steel and aluminum members, concrete-filled steel pipes, and short timbers for transmission use. Eight companies report research aimed at prolonging the useful life of wooden poles, another seeks a new method to determine their remaining life. Others are looking for ways to discourage birds and squirrels from damaging wooden poles. Two companies investigate possibilities of replacing wooden poles with pre-stressed concrete. Determination of the condition of steel tower footings by electro-chemical tests, and means for protecting those footings, are the objectives of one study. EEI itself is sponsoring an investigation

of plant growth inhibitors as applied to trees, and four utilities report projects to improve brush and weed control on rights of way.

Nine companies are working on means of preventing or removing insulator contamination. One is investigating fiber glass as a replacement for porcelain on line insulators, and another considers fiber glass for use in strain insulators in place of wood.

Bundled conductors as a means of controlling corona are being studied by one company, while four are trying to find the cause and cure for corrosion of the steel core in ACSR and copper-covered steel conductors. Several projects deal with various kinds of conductor splices, and some are concerned with problems of corrosion of line hardware.

Thirty-five projects were reported in the field of instruments and testing, a number of them concerned with tracing and locating faults. One of these looks into the possibilities of remote watthour meter reading, using carrier current for transmission of the readings.



General

Among the general engineering research projects reported to the EEI committee, are three on insulating materials. One studies the effect of substances such as hand creams, solvents, and taping compounds on insulation life. Another seeks to determine the most suitable methods for testing insulation life and characteristics. A third probes the chemistry of ions in electrical insulating oils. Other engineering subjects include protective coatings for concrete structures and the embrittlement of steels.

Many utilities are engaged in load research. Studies deal with hourly, daily, and seasonal variation of lighting loads, electric ranges, water heaters, air conditioners, electric house heating, and most other applications. One interesting project is the application of statistical sampling procedures to determine saturation and growth rate in the use of a specific appliance, such as television. Another looks at power factors of standard appliances.

Fourteen investigations of company management subjects were reported. One study is developing local economic indexes; another is working on an improved utility common stock index. Several concern themselves with business organization. And one utility company is studying the long-term effect of the St. Lawrence Seaway on its business.

Many utilities engage in personnel research. Some projects reported were: Development of methods of integrating performance and salary; a study of the effect of automation on employee attitudes; establishment of a comprehensive 'Executive Health Program;" a study of ventricular fibrillation due to electric shock, and how to overcome it; studies of employee communication, arthritis in industry, alcoholism, and accident-prone employees.

Twenty projects are devoted to sales, including studies of the problems of various industries and how they might be solved with electrical applications. Nineteen more are devoted to area development. Many others cover economics—including rate components, depreciation, and the development of formulas to indicate when old equipment should be retired. One company is considering a billing plan using quarterly meter readings.

These are only a few of the projects compiled by the EEI committee. A more complete report of the committee's findings on utility research programs will appear soon in a series of articles by Mr. Seelye in the *EEI Bulletin.*

Build lines to *stay* with the CHANCE 8-WAY

THE EXPANDING ANCHOR WITH ALL 'ROUND HOLDING POWER

All 8-Way Anchor Rods have the Chance-developed Thimbleye that protects your guy strand.

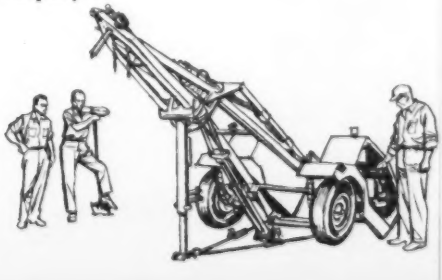
8-WAY EXPANDING ANCHORS FOR STRONGER GUYS · · · Only the Chance 8-Way Expanding Anchor, with its 8 rib reinforced blades, expands into solid earth *all the way around* to form a pyramid-like square.

Chance engineers, who have devoted their careers to developing and testing guying equipment, find that this design adds strength to expanding anchors. The pyramid enlarges the effective area of the anchor's holding power. Blades that expand side by side leave no wasted space between them, can be shorter—less apt to bend, and expand in a wide area of solid earth all around the hole.

That is why field test after field test made for power companies all over the country show that the Chance 8-way usually holds well beyond its rated load, and that is why it is on so many company standards.

Make the Chance 8-way *your* standard for the kind of T and D line guying you can install and forget.

CHANCE FIELD ASSISTANCE AIDS IN ANCHOR SELECTION · · · To assist you in anchor selection, to demonstrate the best installation methods and to test the results under specific soil conditions, the A. B. Chance Co. puts a nationwide team of anchoring experts at your service. These Regional Guying Specialists have the practical experience and technical knowledge to demonstrate proper anchoring to your field men. They have hydraulic testing equipment for on-location field tests to help determine what Chance anchors are right for your system. Call the nearest Chance Regional Manager in your area or ask the Chance Sales Representative to schedule a demonstration for your company.



You can see the Chance 8-way slips right down in a hole no bigger'n the base plate. Now flip this flap to get a mole's eye view of how it expands below "see" level.

Mike the Mole
Underground Observer

Build security
with this 8-wa

Good anc
line sag, l

All 8-Way Anchor Rods have the Chance-developed Thimbleye that protects your guy strand.

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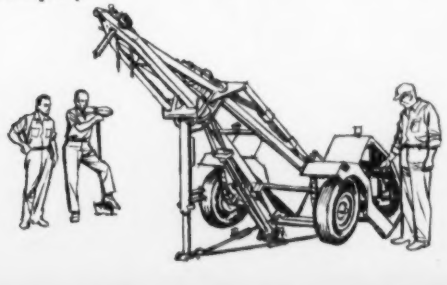
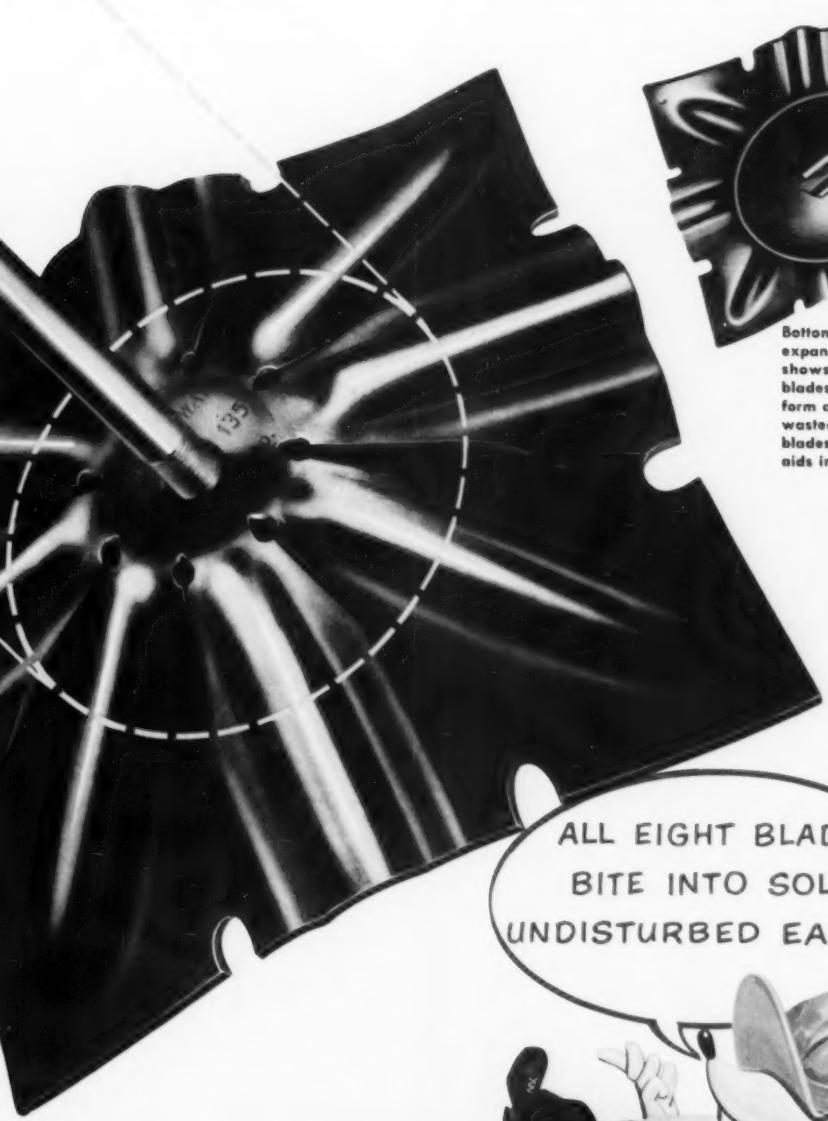


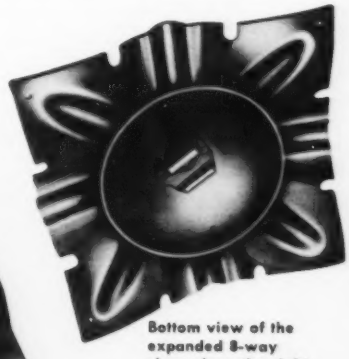
ABC INDUSTRIES

A·B·CHANCE CO.,
(A·B·Chance Co. of

ity into your T and D lines
-way Expanding Anchor...

anchoring is *low-cost insurance* against
ag, leaning poles and storm damage.





Bottom view of the expanded 8-way shows how the eight blades expand to form a square—with no wasted space between blades. Nut retainer aids installation.

E CO., Centralia, Missouri
Co. of Canada, Ltd., Toronto)

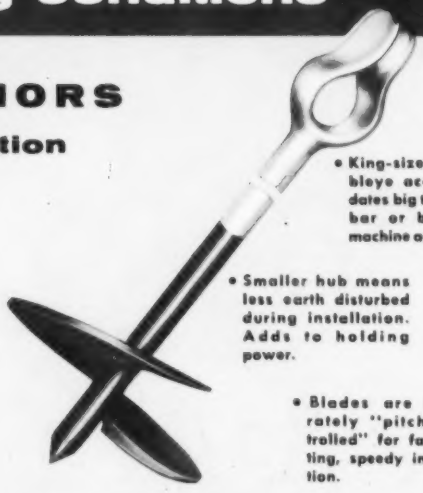
. . . and there are CHANCE ANCHORS for all other soil and guying conditions

CHANCE SCREW ANCHORS

for cost-cutting machine installation or hand installation

Many utilities which use screw anchors cut their installation time to a fraction by installing Chance Screw Anchors with hole boring equipment. They use the Chance "Blackfoot"* anchor because it is designed to screw down fast with little earth disturbance. This not only means less difficulty with installation equipment, but greater holding power and easier installation of the anchors that are to be screwed down by hand.

*The line crew's name for the line crew's choice.



- King-size thimbleye accomodates big turning bar or boring machine adapter.
- Smaller hub means less earth disturbed during installation. Adds to holding power.
- Blades are accurately "pitch-controlled" for fast-cutting, speedy installation.

CHANCE PLATE ANCHORS

for heavy transmission line guying

CHANCE CROSS-PLATE ANCHOR

When you're guying "big stuff" like transmission lines, you want anchors that will hold the load for the life of the lines.

The Chance Cross-Plate Anchor was designed specifically for installation in vertical machine bored holes to save time and money on transmission line construction. Costs 50% less than a log dead-man —holds more.

Chance Never-Creep Anchors pull entirely against solid, undisturbed earth to hold more load than any other type. Installed in angled hole —hand or machine bored.

Send for Bulletin 865: "How to Get Better Transmission Line Guying for Less."

CHANCE NEVER-CREEP ANCHOR

FOR ROCKY AREAS

Chance Expanding Rock Anchors wedge into solid rock. Chance Cone Anchors wedge against tamped rock.

FOR SWAMPLAND

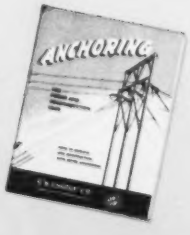
Chance Swamp Screw Anchors screw down to any depth required for a firm grip.

FOR POLE KEYING

Chance Pole Keys expand at the butt of the pole for reinforcement in soft soil. Eliminate need for trench digging to install keys.

SEND FOR YOUR COPIES OF "ANCHORING"

Here is the most complete guide to better anchoring ever developed. It's full of how-to-do-it material to help you select the right anchor for every guying job—and get it installed properly.



A•B•CHANCE CO., Centralia, Missouri

(A•B•Chance Co. of Canada, Ltd., Toronto)

CA58-1

Subsidiaries of NEES Elect Three New Vp's

BOWER

NICHOLS

New England Electric System has made these appointments: Edward C. Bower to vice president and general manager of Merrimack-Essex Electric Co; Edward F. Ziegler to vice president of the New England Power Service Co; Guy W. Nichols Jr, to vice president and manager of the Southern Berkshire Power & Electric Co; and William M. F. Seymour to area development manager of the New England Electric System.

Bower joined NEES in 1926 at Lowell as a student engineer. He later held several supervisory and managerial posts in the system subsidiaries. In 1949 he was named district manager and vice president of the system's North Shore companies. Since 1952 he has been responsible for all sales promotion and new business northeast of Boston.

Ziegler entered the system in 1929 as district engineer at Lawrence, Mass. He was made vice president of the Lowell company in 1943. He became assistant district manager in 1948 and in 1952 was appointed vice president in charge of labor relations for the system.

Nichols came to NEES in 1947 as a student trainee with Worcester County Electric Co. Later he was named technical assistant and in 1955 was made assistant superintendent of distribution. In 1957 he was appointed executive assistant of NEES in Boston.

Seymour joined NEES in 1930 at North Adams, Mass. He has been engaged in sales managerial work in the western part of Massachusetts served by NEES subsidiaries.

ZIEGLER

SEYMOUR

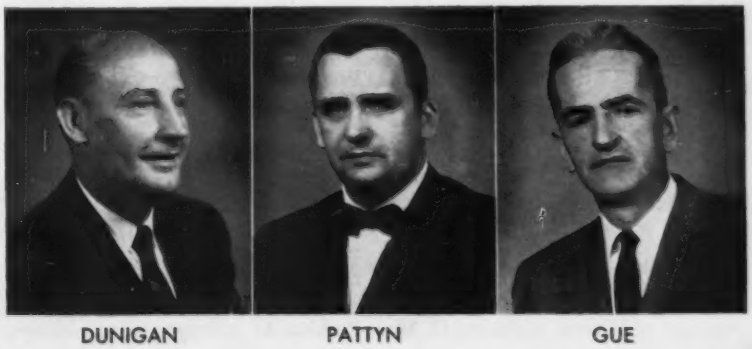
Vp's Named by Public Service of Indiana

Public Service Co. of Indiana has elected John R. Dunigan vice president in charge of planning, Edwin M. Gue vice president in charge of engineering, and Remi C. Pattyn vice president in charge of personnel relations.

Dunigan joined the company in 1946 and was appointed assistant comptroller in 1951. He had previously been with the Consolidated Edison Co of New York. He also had served on the New York Public Service Commission staff as senior accountant. He was later with the Securities & Exchange Commission as financial analyst.

Gue has had 26 years experience in the electric utility industry. He was with Potomac Electric Power Co for five years. In 1937 he joined Duquesne Light Co where he served as senior engineer, electrical station engineer, electrical design engineer, and most recently, as system planning engineer, the position he held before joining Public Service.

Pattyn has been engaged in responsible positions in management, administration, personnel, electrical manufacturing, and engineering with various firms in Chicago, including International Register Co. Prior to joining Public Service he was director of personnel and assistant secretary for Chicago Aerial Industries, Melrose Park, Ill.



DUNIGAN PATTYN GUE

PEA Elects Officers for 1958-59

Pennsylvania Electric Association has elected A. D. Root president, succeeding J. O. Chambers who is vice president of West Penn Power Co. Root is financial vice president and director of Pennsylvania Power & Light Co.

Other PEA officers elected as vice presidents were: Walter J. Lyman, Duquesne Light Co, G. R. Parry, Metropolitan Edison Co, and Park R. Lawson, Pennsylvania Electric Co.

Shown in the picture above are: Root, Parry, and Lyman. Lawson was missing when photo was taken.

PERSONAL BRIEFS

Howard E. Clark has joined the industrial relations department of Commonwealth Services Inc. He will work as a consultant in the areas of organization development, union-management relations, wage and salary administration, and other personnel problems.

Wisconsin Power & Light Co has elected **C. C. Hermann,** who is vice president and treasurer, to the board of directors.

Gulf States Utilities Co has made these personnel changes: **Thomas P. Comerford** to assistant secretary; and **Ben Reeves Garrison** to chief clerk in the Baton Rouge Division.

Thomas H. Burwell has been named manager of the Thomasville office of Duke Power Co.

Potomac Edison Co has appointed **T. J. McCaleb** to the newly-created post of maintenance supervisor.

Western Light & Telephone Co has appointed **Fred V. Moffett** district manager of Liberal, replacing **G. M. Crow** who becomes manager of the company's Eastern Division.

Archie L. King has been promoted to superintendent of the Meter department of Toledo Edison Co, succeeding **Earle E. Diehl,** retired.

Ebasco Services Inc has made these personnel changes: **Frederick C. Tonetti** to assistant director of research and **Howard C. Happe** to supervisor of travel and hotel arrangements in the traffic department.

These people have retired recently: **Joe S. Lessig,** manager of the Warsaw, Ind., district of Northern Indiana Public Service Co; **Jubal A. Hale,** vice president of Utah Power & Light Co, and **Thomas W. Connette,** vice president and Western Division manager of New York State Electric & Gas Corp.

Federal Pacific Electric Co has made these two engineering appointments:
Dr. Andrew A. Halacsy to staff development specialist and **Gordon O. Perkins** to manager of company's development engineering department, Eastern Switchgear Division.

A. N. Haig has been appointed as engineer-in-charge, sales and engineering, of a newly-formed accelerator section in the motor and generator department of Allis-Chalmers Manufacturing Co.

John Faller has accepted a position as a reactor engineer with the Atomic Energy Division of Phillips Petroleum Co.

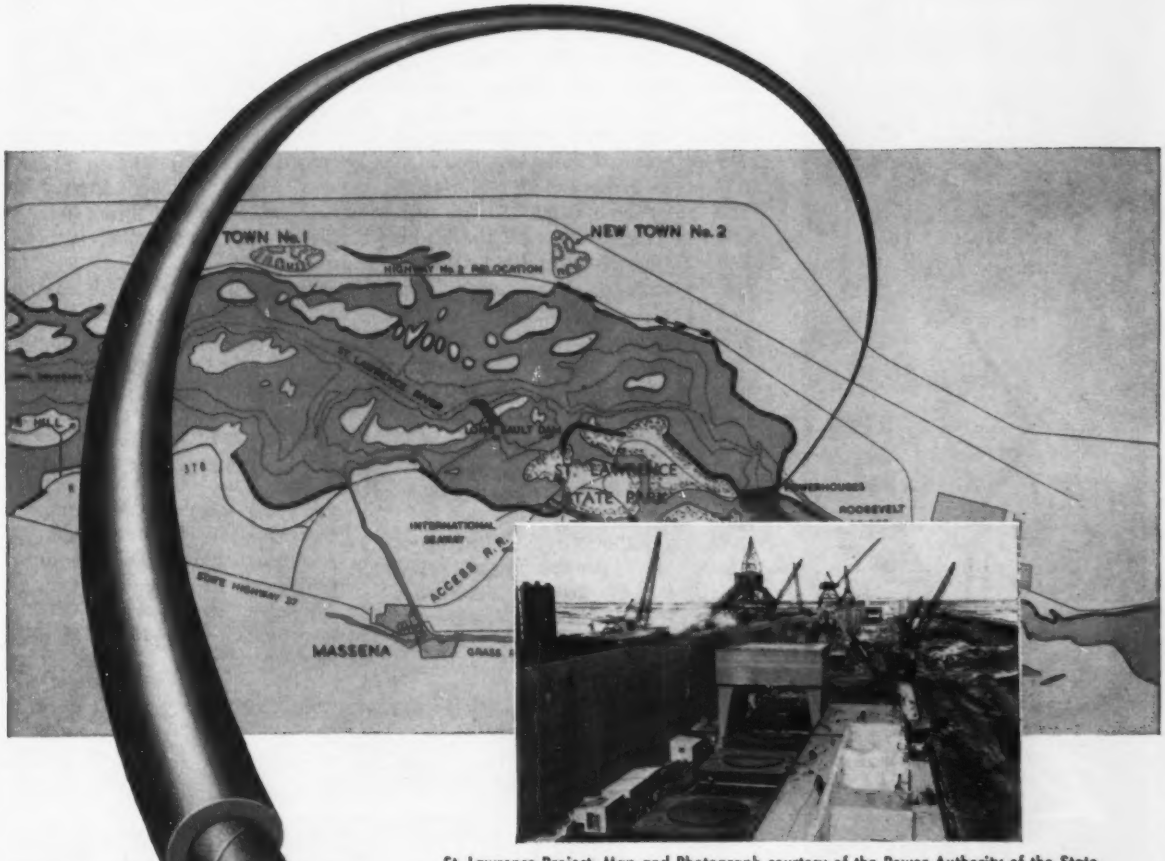
Gavin S. Younkin, vice-president and general sales manager of Minneapolis-Honeywell Regulator Co, is taking over the sales activities of the company's Datamatic Division.

Anaconda Co has made these organizational changes: **Russell B. Caples,** who has been vice president in charge of metallurgical operations, will continue as a vice president. **William Wraith, Jr,** has been advanced to the newly-created position of metallurgical manager and **Thomas K. Graham** has been advanced to assistant metallurgical manager.

John A. Houston has been appointed assistant general manager of the Philadelphia steel service plant of Joseph T. Ryerson & Son, Inc.

General Electric Co has announced the following personnel changes: **Robert L. Bartlett** will supervise a newly-formed engineering cost analysis component for the company's large steam turbine-generator department. **William C. Crutcher** has been named a patent attorney for GE's Turbine Division. In the Chemical and Metallurgical Division, **Dr. A. Eugene Schubert** has been appointed general manager of the chemical materials department, succeeding **Sam L. Brous,** who will be marketing manager. **James W. Raynolds,** previous marketing manager, has been assigned as a consultant to the division general manager. **H. J. Flaherty,** former manager of the lighting department's engineering laboratory, has retired after more than 41 years of service. **Dr. John A. Loritsch** has been named manager of manufacturing in a reorganization of GE's insulating section of the chemicals materials department.

Another call for Collyer . . .



St. Lawrence Project: Map and Photograph courtesy of the Power Authority of the State of New York. Project Engineers: Uhl, Hall & Rich, Boston, Mass., and Massena, N. Y.

At the St. Lawrence Power Project . . . COLLYER CONTROL CABLE

Style RR with RH-RW Insulation

THE VAST ENERGY POTENTIAL of the mighty St. Lawrence River is being harnessed in a power project of tremendous proportions, a joint effort of the Power Authority of the State of New York and the Hydro-Electric Power Commission of Ontario.

This multi-million dollar project is a monument to man's imagination, engineering genius, and peaceful cooperation. Collyer is proud to have been selected to supply the control cable which is to be used in the production, regulation and distribution of the tremendous quantities of electric energy which will be produced here.

MANY OF THE CONDUIT RUNS, although encased in concrete, are subject to adverse moisture conditions. The good aging characteristics of Collyer RR Control Cable (similar to Collyer C-101) with RH-RW insulation and neoprene-jacketed conductors, and the ability of Collyer RR Control Cable to meet the high engineering standards required on this job led to its selection for this vital service.

WHEN SEVERE ENVIRONMENTAL CONDITIONS require long-life, maximum service Control Cable, more and more engineers and contractors "Call for Collyer." Let us quote on your specific requirements. Write **Collyer Insulated Wire Co., 247 Roosevelt Ave., Pawtucket, Rhode Island.**

LIVE BETTER ELECTRICALLY

Collyer

Power Cables • Control Cables
Switchboard Wires • Service Cables
Series Lighting Cables • Building Wires

ONE MAN CAN MEASURE FASTER, MORE ACCURATELY

WITH A Rolatape MEASURING WHEEL

Take all your outdoor measurements this modern, time saving way. ROLATAPE reduces the risk of human error, since it records precise measurements in feet as it is rolled along—automatically and in full view of the operator. Sturdy, lightweight; equipped with automatic brake and built-in stand. Handle folds compactly.

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FIRM .....
ADDRESS .....
CITY, STATE .....

Big Net, Skimmers, Installed at Brownlee

(*Continued from page* 65)

required to operate the Brownlee facilities. In addition to two 15-hp main pumps, each skimmer has a 10-hp holding tank pump for maintaining tank level automatically, a 7½-hp screen wash pump, and miscellaneous drives for air compressor and other auxiliaries. At the fish lock, the main loads are the 50-hp fish lock pump and hydraulic pumps for the screen-position control.

Power is supplied from a 225-kva, 3-phase, 12.5-kv to 480-v, grounded-wye substation located near the truck loading station on the Idaho shore.

From the substation, a single 480-v, rubber-insulated, neoprene-jacketed, 3-conductor power cable, lying in cable trays on the net's walkway, connects to weatherproof motor control centers on each skimmer and at the fish lock. The trays also carry 9-conductor control cables for the remote and automatic sequence circuits, and communications cables.

Peak demand on the substation, including lighting, is estimated at about 200 kw. Annual usage is expected to be about 850,000 kwhr.

Brownlee's four 90-Mw machines are scheduled for completion by December, with first power expected in September. Reservoir filling behind the 6,000,000 cu yd rockfill dam began May 9.

Oxbow, a 190-Mw producer, the second of the three dams Idaho Power plans for the Hells Canyon reach of the Snake, is scheduled for completion in 1960.

Water erosion to the fish trap for upstream migrants, located below Oxbow Dam, forced a short reduction in flow from Brownlee on Aug. 31 while emergency repairs were made. The installation is now operating as planned.

Sees Modernization Outlays Up

(*Continued from page* 66)

to unemployed and retired persons and sustained consumer buying in non-durables.

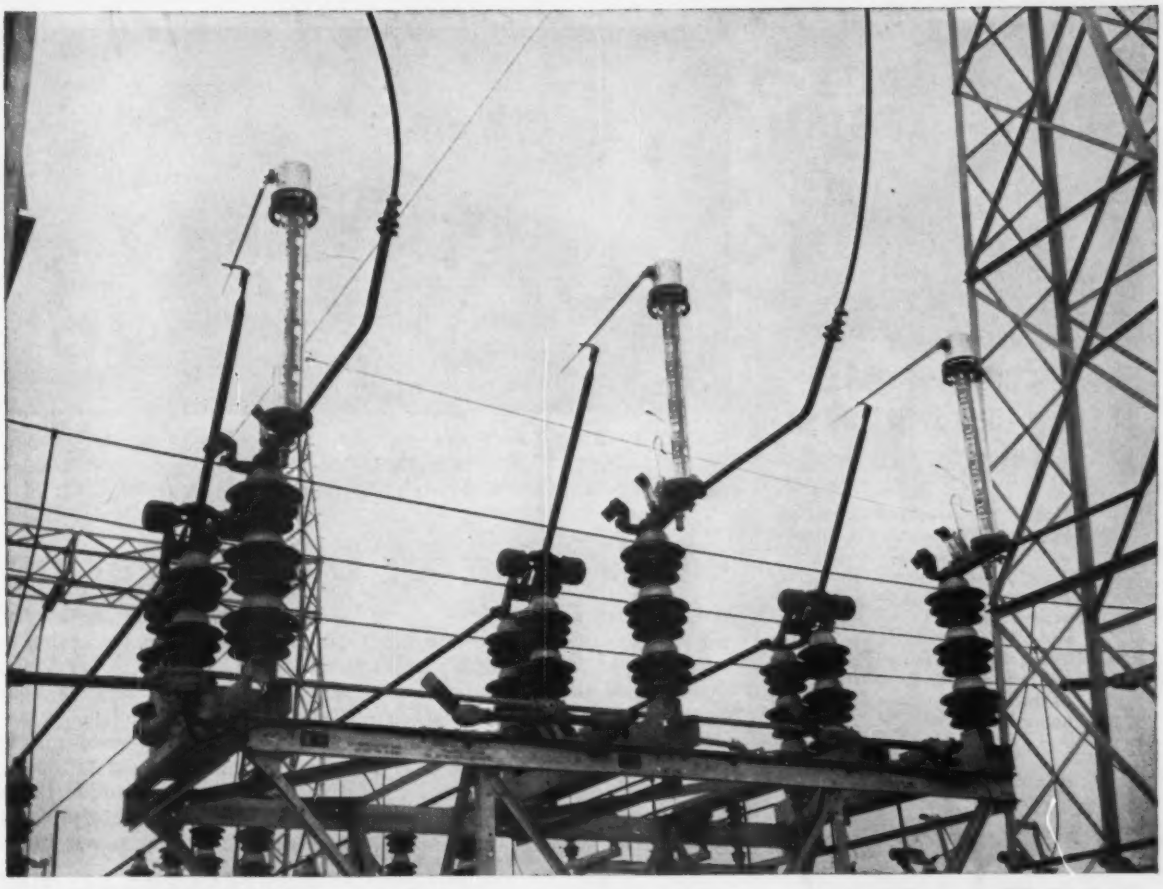
The most dramatic phase of the economy, said G. C. Tenney, McGraw-Hill Publishing Co vice president, is the upsurge in research and development expenditures and sales of resulting products during this decade. The greatest effect of these programs will be felt in the mid-sixties and after, he predicted. As an example of industries spurred by research and development programs, Tenney cited electronics' output increase of 185% in the past decade, plastics' 175%, and aluminum's 200%.

Recent studies indicated that industries with the highest ratio of research to sales have also the highest profit ratios, and this could be a good investment indicator, Tenney said.

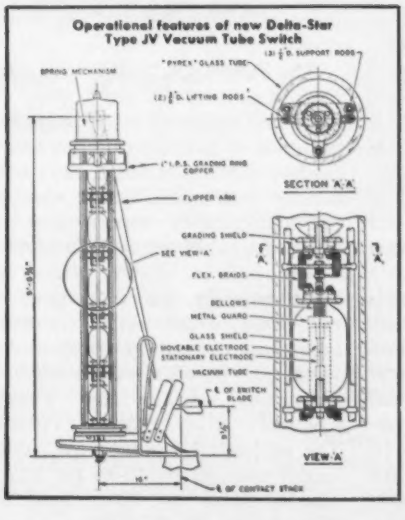
There are about 1,200 different known types of nuclear reactors, and the surface of knowledge of which types are optimum has barely been scratched, said W. L. Budge, Westinghouse Electric Corp. International exchange of information at the UN Conference on Peaceful Uses of Atomic Energy at Geneva was excellent, but little previously unknown data were released, he reported. The USSR program seems to follow the US' program closely, almost step-by-step, he said.

Convenience, sales power and economy of operation are three major contributions alert electrical distributors can make to the growth of the industry, NELPA was told by W. E. Henges, president, Graybar Electric Co. The distributor actually adds value to products based on their immediate availability to customers from his stocks, he added. During emergencies, distributors have been of great aid in providing rush service on stocked supplies and quick knowledge as to availability of other materials.

NELPA elected as its new president Tom Ingledow, vice president, British Columbia Electric Co, who succeeds John Kimball, Idaho Power Co vice president.



FOR INTERRUPTING HIGH LOAD AND CAPACITIVE CIRCUITS



—the DELTA-STAR MKV-40 Vacuum Tube Switch

RATINGS UP TO 138kv. The new Delta-Star MKV-40 Vacuum Tube Interrupter Switch answers the need for a high-voltage, high-current interrupting device of long service life at reasonable cost.

Especially well suited for switching capacitive loads, the MKV-40 operates on a thoroughly proved principle whereby the series of high-dielectric-strength Jennings vacuum tubes is in the circuit only during the interrupting cycle. Tubes are also relieved of the duty of re-making the circuit. Long, reliable service life is thereby designed into this high-current interrupter.

Positive interruption occurs at first current zero, and restrikes are eliminated by the high dielectric strength of the vacuum switch. The vacuum tube switch is maintenance-free throughout. Currents as high as 600A (load) and 200A (capacitive) may be handled with an expected service life of 5,000 operations.

For prints and technical literature, call your nearest Delta-Star representative, or write today direct to *Dept. 117 Delta-Star Electric Division, H. K. Porter Company, Inc., 2437 Fulton Street, Chicago 12, Illinois. District offices in principal cities.*

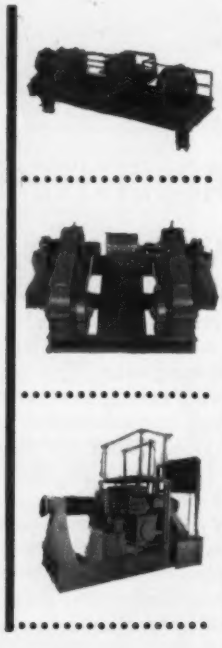
H. K. PORTER COMPANY, INC.

DELTA-STAR ELECTRIC DIVISION

Connors Steel, Delta-Star Electric, Disston, Forge & Fittings, Leschen Wire Rope, Quaker Rubber, Refractories, Riverside-Alloy Metal, Vulcan-Kidd Steel, H. K. Porter Company (Canada) Ltd.

....to CONTROL WATER LEVEL at LONG SAULT DAM, ST. LAWRENCE PROJECT

Each hoist weighs 93,000 lbs., shipped completely equipped with all electric motors, controls, limit switches, wired ready for operation . . . the overall length of one unit is 57 feet, 8½ feet wide 12½ feet high . . . with a lifting capacity of 175 tons . . . will raise and lower the gates in the dam at a speed of 1 foot per minute.



This is one type of Gate Hoist designed and manufactured by us, backed by 75 years' experience. MURCO Gate Hoists are designed in a wide range of capacities from this large Gate Hoist to less than one ton.

Write for complete information on MURCO Gate Hoists and engineering recommendations to meet your specific power dam requirements.

D. J. MURRAY MANUFACTURING CO.

WAUSAU OUR 75TH YEAR 1883 TO 1958 WISCONSIN

N. C. DEZENDORF, General Motors (center), addressed Rocky Mountain League's Wyoming meeting. Other speakers were (left and right): L. W. McLeod, Westinghouse vice president; B. M. Gadsby, Utah P&L board chairman

Gives Case for Diesel Peaking

Diesel-electric generating plants for peaking operation can save substantial capital investment in generation-addition programs, the Rocky Moutain Electrical League was told at its annual convention at Jackson Lake, Wyom., Sept. 15-17.

Reliable, soundproofed, 6 to 8-Mw plants can be installed for less than $100 per kw, said N. C. Dezendorf, General Motors Corp. Started remotely on peak demand and achieving full load in 90 sec, the plants operate in the portion of the load-duration curve where 20% of a utility's capacity is used as little as 10% of the time, he said.

Under conventional generation addition patterns, Dezendorf said, new high-efficiency steam plants are pushed into low plant factor operation within 10 to 12 years, so they are base-loaded for only a third of service life. But if diesels are added now to carry the peaks, postponement of appreciable high-efficiency capacity and extension of base-loading years can be effected.

Study of a 100-Mw utility showed $27 million, spent over 10 years to meet growth with conventional generation, could be cut to $13 million by adding peaking diesels.

Research and development for the electric utility industry is carried by a unique partnership of utilities and manufacturers, said L. W. McLeod, Westinghouse Electric Corp. Often the industry has built its own research facilities when others wouldn't cooperate, he noted.

A "new look" in atomic energy —one of hard realism—has replaced 1954's excessive optimism, said G. M. Gadsby, Utah Power & Light Co. The Congress' Joint Committee on Atomic Energy and the AEC have recognized this by recent definition of the "Proposed Expanded Civilian Nuclear Power Program" as "the demonstration of economic nuclear power in the US by 1970."

The proposed program would develop information and not power *per se*, Gadsby said, and the two agencies have recognized the possibility of deletion of the preference clause.

The industry is "still in the forebay" of nonprofit research, development and construction without expectation of recouping dollars spent, Gadsby continued. But the justification is there: Ultimate cheaper production with conservation of non-replaceable natural resources.

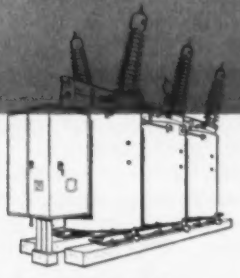
The bulk of future power requirements in the Arizona-Colorado-New Mexico-Utah-Wyoming area must be met by conventional steam of investor-owned electric companies, despite the federal Colorado River Storage Project. The project's 1.1-million kw would supply only an eighth of the area's growth needs by 1980, said R. Sargent Jr., Public Service Co of Colorado.

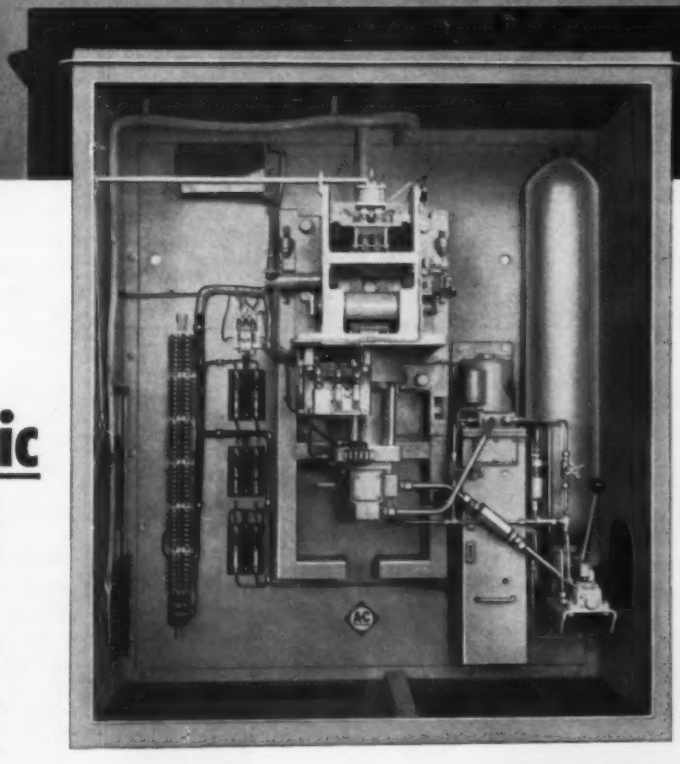
The RMEL group elected J. E. Wilson, Colorado Central Power Co vice president, as league president, to succeed Veryl Hoover, Pacific Power & Light Co.

Plan to stay ahead... MODERNIZE!

CENSORED

Chemical company prefers that no photographs be taken in plant area.





Breaker with Pneu-Draulic Operator

serves where humans can't

SO_2 concentrations chase men from area where Allis-Chalmers breaker serves as bus tie between mill and utility

The corrosion resistance of the *Pneu-Draulic* operator has been proved over the past two years by satisfactory operation in a highly corrosive atmosphere.

Nameplates were unreadable after two years and were replaced by stainless steel plates, but the *Pneu-Draulic* operator is still in excellent working condition.

One reason: all motivating parts are immersed in oil and this oil inhibits corrosion. Another factor: this system does not require the intake of large volumes of surrounding air as with pneumatic units.

Whether or not you have a corrosion problem you will profit from the reliability of Allis-Chalmers oil circuit breakers with *Pneu-Draulic* operators.

For details, call your nearby A-C office or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

Pneu-Draulic is an Allis-Chalmers trademark.

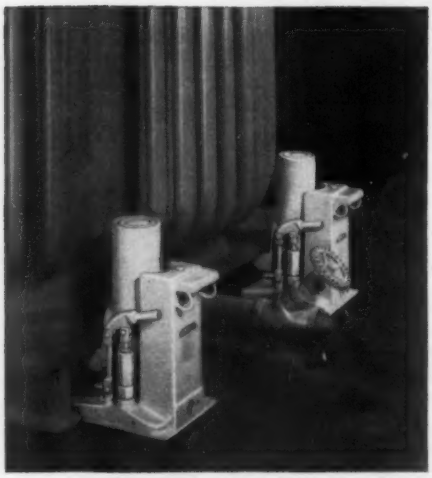
The features behind the story!

1. **Safety** — Mechanically trip-free operation
2. **Simplicity** — One control valve system
3. **Corrosion resistance** — All motivating parts immersed in oil
4. **Manual operation** as well as electrical operation under load
5. **No winterizing** — Consistent operation under extreme temperature changes.

A-C ALLIS-CHALMERS

A-5811

Unique Transformer Jack Lifts Full Capacity on Toe or Cap



Exclusive design accounts for the success of this series of jacks. The roller bearing in the toe transmits eccentric toe loading to the flat milled surface on the stationary ram. This completely eliminates scoring action which is inherent in conventional toe lift hydraulic jacks. Lifts full capacity on both the toe or the cap.

Double pumps provide both speed and power. A safety by-pass prevents overloading. Ideal for lifting heavy machinery and transformers with minimum jacking clearances. Can also be used horizontally. Write for catalog.

Jack No.	Capacity Tons	Weight Lb.	Closed Height Inches	Travel Inches	Toe	Base Forked Design
TJ-10	10	54	11¾	6	Min. Ht. 1¾" Width 3"	9½"x8"
TJ-25	25	110	14	7	Min. Ht. 2½" Width 4½"	9"x12"
TJ-50	50	230	18	10	Min. Ht. 3½" Width 5½"	11½"x14¼"

TEMPLETON, KENLY & CO., 2515 Gardner Road, Broadview, Illinois

IDEAS AND PEOPLE MEET AT THE POWER SHOW, ED. I CRAM DOZENS OF CRUCIAL CONTACTS INTO MY VISIT TO THE SHOW. I SOLVE PROBLEMS, AND GET MANY NEW IDEAS FOR CUTTING COSTS IN THE PLANT.
YES, BILL. THAT'S WHY I BRING MY KEY MEN ALONG. THEY GET A NEW PERSPECTIVE ON THE INDUSTRY, AND THE FUTURE. THEY GO BACK TO THEIR JOBS RECHARGED WITH IDEAS. THEY'RE WORTH MORE TO OUR COMPANY, AND I AM TOO.
ELECTRUNITE TUBING

You, too, will find new ways of cutting costs at the

23rd National Exposition of Power & Mechanical Engineering

Auspices of ASME

New York Coliseum December 1—5, 1958

The Power Show is held in conjunction with the annual meeting of the American Society of Mechanical Engineers. Don't miss it! Register by mail today and save time later. No charge. Write to the Exposition at 480 Lexington Avenue, New York 17, N. Y.

Management: International Exposition Company

Sales Assignments

COMPANY STAFFS

Electric Storage Battery Co, Exide Industrial Division, has named Evans Taylor branch sales manager of the Chicago area.

Elliott Co has promoted J. R. Lemmon to eastern region manager, with headquarters in Philadelphia. H. D. Moll succeeds Lemmon as district manager of the Philadelphia office.

Sylvania Electric Products Inc, Sylvania Lighting Products Division, has named Thomas H. Cashin as product sales manager of industrial-commercial lamp sales.

Allis-Chalmers Manufacturing Co has appointed Frederick H. Linley, Jr, northeast regional representative for power plant equipment. J. E. Watson, Jr, has become manager of the company's New Orleans District succeeding R. F. Muller, retired. W. E. Scott has been named manager of the Miami District.

Smithcraft Lighting has announced the appointment of E. A. Fargis as southern regional sales manager, with headquarters in Atlanta.

REPRESENTATIVES

Waterman Products Co has announced a new marketing policy for its line of equipment. The following distributors have been appointed to act as master jobbers: Radio Shack Corp, Boston and New Haven; Terminal Radio Corp, New York; Rochester Radio Supply, Rochester, N. Y.; Syracuse Radio Supply, Syracuse, N. Y.; General Radio Supply Co, Camden, N. J.; MG Electrical Equipment Co, Birmingham, Ala.; Wholesale Radio Parts Co, Inc, Baltimore; Electronic Wholesalers, Inc, Washington; Radio Equipment Corp, Buffalo; and Radio Specialties Co, Detroit.

Chester Cable Corp has appointed the following representatives for its electronics division: A. C. Wahl Inc, Cincinnati, to handle sales in Kentucky and southern Ohio; and R. C. Warner Sales Engineering Co, Sturgis, Mich., to handle Indiana and Michigan areas.

TWO IMPORTANT NEW FACTS ABOUT KAISER ALUMINUM AAAC

1. AAAC now available on an unlimited basis!

In the three years since Kaiser Aluminum first introduced AAAC, this revolutionary new all aluminum alloy conductor has been offered on a limited basis so that we could keep accurate records of its performance.

During this time, over two million pounds of Kaiser Aluminum AAAC—installed in widely varying locations—have been thoroughly tested and job proved. Results of these 3-year tests prove conclusively that AAAC offers remarkable new advantages in performance, economy and corrosion resistance.

These results have *far exceeded* our most optimistic expectations and we are now ready to offer AAAC for unlimited general use.

2. AAAC accessories now available from leading accessories manufacturers!

Leading manufacturers of armor rods, automatic splices and compression joints have recently established a full range of availabilities for these accessories. You'll find them listed and priced in published catalogs.

Many of these accessories have been tested on the same installations used by Kaiser Aluminum for proving AAAC. These tests have resulted in simplified installation techniques for miles of installed lines.

Your present KW distributor is a dependable source of top quality AAAC accessories.

KAISER ALUMINUM

IF IT CARRIES CURRENT, K/W CARRIES IT!

SEND FOR FREE AAAC BOOKLET

Yours for the asking...all the facts about new Kaiser Aluminum AAAC, complete with engineering data and ordering information, wrapped up in a concise, informative booklet. Get your copy now by mailing in the handy coupon below.

PLEASE SEND YOUR FREE BOOKLET CONTAINING FULL DETAILS ABOUT AAAC

Kaiser Aluminum & Chemical Sales, Inc.
Dept. 952
919 N. Michigan Avenue, Chicago 11, Ill.

Please send your free booklet containing full details about AAAC.

Name_____

Address_____

City_____ State_____

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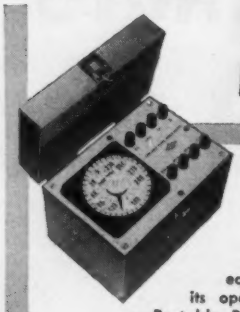
PORTABLE PHASE ANGLE METER



Completely self-contained, and requiring no auxiliary equipment for its operation, this Portable Phase Angle Meter offers a direct way of checking relay and instrument connections, particularly directional over-current relays, differential relays or similar equipment. It may also be used to measure the prevailing power factor in each phase of a polyphase watthour meter installation. The device has a frequency of 60 cycle, with voltage ranges of 60, 120 and 240 volt. Current ranges are 1, 2.5 and 5 amp. . . . DIMENSIONS: 9½ x 6¾ x 5⅝ inches. Weight 19 pounds.

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Lube Study Helps Cut Maintenance Cost

A recent study on lubrication for power stations has helped cut maintenance costs at Atlantic City Electric Co's Deepwater Station. Undertaken by Gulf Oil Corp engineers, the study embraced operation and function of the plant's 118 different types of equipment, and led to a reduction of lubricants to nine plant oils, three plant greases and four automotive lubricants.

The reduction "benefits us in a number of ways," according to B. H. Cheeseman, supervisor of Deepwater operations. "Our purchasing orders are simplified. We carry fewer types of greases and oils to do a better job. There is less reordering because we can carry larger stocks." It also lessens chance of workers using wrong lubricant, Cheeseman says.

Two Utilities Set 1.5¢ Kwhr Heating Rate

Duke Power Co has filed applications for a 1.5¢ per kwhr rate for all-electric residential customers using more than 200 kwhr a month. Meanwhile Louisville Gas & Electric Co on Oct. 1 put into effect its 1.5¢ rate for house space heating.

The Duke application, now under study by North and South Carolina commissions, would lower the bottom step from 2¢ per kwhr. Louisville G&E's change, also a drop from the 2¢ step, will apply on consumption above 600 kwhr a month from October through May. The company has 30 electric heating customers and expects to add about 600 a year under the new rate.

Two men and a spinner

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Bright new middleweight and heavyweight might! New big-tonnage L.C.F. and conventional trucks are heftier than ever with new 5-speed transmissions, new huskier clutches, more durable rear axles in capacities as high as 18,000 lbs.! G.V.W.'s go up to 36,000 lbs. in tandems . . . and up to 21,000 lbs. in new Series 50H and 60H models with heavy-duty components!

New thriftier 6's, all-new V8 power! Chevy's best selling 6's are set to pinch pennies like never before with new camshaft design, new valve train durability! *Six* modern V8's are tougher built for bigger savings; an all-new V8, the 185-h.p. Workmaster Special* with advanced Wedge-Head design, is offered in Series 70 and 80! See 'em for yourself—the bright new trucks of Task-Force 59 at your dealer's now! . . . Chevrolet Division of General Motors, Detroit 2, Michigan.

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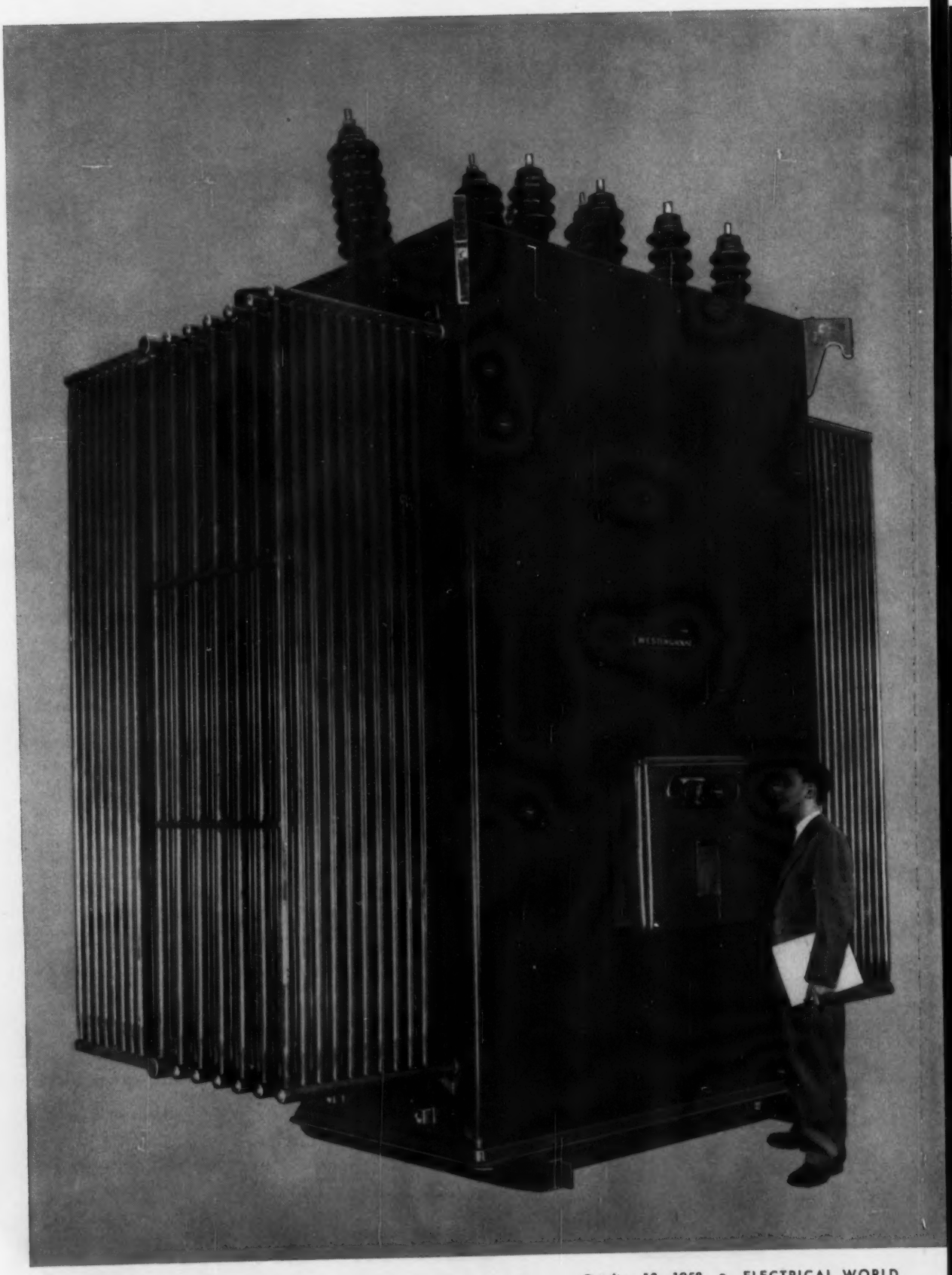

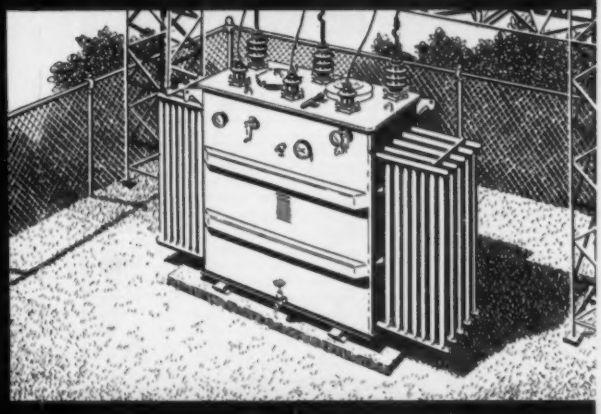

THROUGH PLOWBACK OF EARNINGS WESTINGHOUSE CONTINUES DEVELOPMENT OF BETTER, QUIETER DESIGNS WITH IMPROVED APPEARANCE

Mr. R. L. Schwab, Manager, Network & Power Transformer Engineering, inspects the new streamlined design transformer, available in ASA ratings 750 through 10,000 kva, 69 kv and below, 3 phase.

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Books

What Is Noise?

Principles of Noise. By J. J. Freeman. Published by John Wiley & Sons, Inc, 440 Fourth Ave, New York 16, N. Y. 292 pages, illustrated. Price $9.25.

This is a highly technical approach to the phenomenon called noise. Principles and techniques used in the analysis of noise are presented. Knowledge of higher mathematics is a prerequisite.

Fundamentals of Higher Math

Mathematics of Physics and Modern Engineering. By I. S. Sokolnikoff and R. M. Redheffer. Published by McGraw-Hill Book Co, 330 West 42nd St, New York 36, N. Y. 810 pages, illustrated. Price $9.50.

This text is designed as an introduction to applied mathematics. The book presents the fundamentals to be mastered rather than concrete applications. A complete mastery of college mathematics courses is necessary to the use of this text.

Higher Math for Engineers

Operational Mathematics, Second Edition. By R. V. Churchill. Published by McGraw-Hill Book Co., 330 West 42nd St, New York 36, N. Y. 320 pages, illustrated. Price $7.00.

Laplace and other integral transformers are the subject of this highly technical book. Mathematics through advanced calculus is a prerequisite. Certain applications, such as heat conduction and mechanical vibrations, are discussed.

Electricity on the Farm

Electricity in Agricultural Engineering. By T. E. Hienton, D. E. Wiant and O. A. Brown. Published by John Wiley & Sons, Inc, 440 Fourth Ave, New York 16, N. Y. 380 pages, illustrated. Price $7.75.

Basically, this is a text on the fundamentals of electricity, electric circuits, and electrical equipment. Most of the equipment is discussed as it pertains to the farm. And the authors present one complete chapter on farmstead electric distribution.

Books Recently Received

High Dams and Upstream Storage. Edited by A. W. Stone. Published by Montana State University Press, Missoula, Mont. 173 pages. Price $3.50.

Pip Fact Finder. Published by Electric Companies Public Information Program. 2 West 45th St, New York 36, N. Y. 206 pages. Price $5.00.

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The Meetings Calendar

OCTOBER

Controllers Institute of America—27th Annual National Conference, Chalfonte-Haddon Hall, Atlantic City, N. J., Oct. 19-22.

Pennsylvania Electric Association—Communications Committee, Benjamin Franklin Hotel, Philadelphia, Pa., Oct. 20-21; Systems Operation Committee, Skytop, Pa., Oct. 23-24; Electrical Equipment Committee, Abraham Lincoln Hotel, Reading, Pa., Oct. 30-31.

University of Texas—Eleventh Annual Power Distribution Conference, Austin, Tex., Oct. 20-22.

Southeastern Electric Exchange—Engineering & Operation Section, Hotel Roanoke, Roanoke, Va., Oct. 20-21; Accounting Conference, Roosevelt Hotel, New Orleans, La., Oct. 30-31.

American Institute of Electrical Engineers—4th Annual Farm Electrification Conference, Hotel Monteleone, New Orleans, La., Oct. 20-22; Fall General Meeting, Penn Sheraton Hotel, Pittsburgh, Pa., Oct. 27-31.

Edison Electric Institute—Taxation Accounting Committee, co-sponsored by AGA, Tides Hotel and Bath Club, St. Petersburg, Fla., Oct. 22-24; Home Service Committee, St. Louis, Mo., Oct. 28-29.

• **Great Lakes Power Club**—Fall Meeting, Hotel Orlando, Decatur, Ill., Oct. 23-24.

National Society of Professional Engineers—Fall Meeting, St. Francis Hotel, San Francisco, Calif., Oct. 23-25.

Oklahoma Utilities Association—Accounting Section Conference, Burlingame Hotel, Bartlesville, Okla., Oct. 24.

Kansas Association of Municipal Utilities—30th Annual Convention, Broadview Hotel, Wichita, Kansas, Oct. 26-28.

• **Computer Applications Symposium**—Sponsored by Armour Research Foundation of Illinois Institute of Technology, Morrison Hotel, Chicago, Ill., Oct. 29-30.

NOVEMBER

• **New Jersey Utilities Association**—Annual Meeting, Seaview Country Club, Absecon, N. J., Nov. 5-7.

• **Pennsylvania Electric Association**—Fall Relay Committee, Americus Hotel, Allentown, Pa., Nov. 6-7; Transmission and Distribution Committee, Mountain View Hotel, Greensburg, Pa., Nov. 13-14.

• **The Institute of Radio Engineers**—Fifth Annual National Meeting of the Professional Group on Nuclear Science, San Mateo, Calif., Nov. 6-7.

• **Atomic Industrial Forum**—Annual Conference, Shoreham Hotel, Washington, D. C., Nov. 10-12.

• **Edison Electric Institute**—Accident Prevention Committee, Hotel McAlpin, New York City, Nov. 10-12; Industrial Power & Heating Group, Pittsburgh, Pa., Nov. 19-21; Commercial Lighting Committee, Philadelphia, Pa., Nov. 20-21.

• **National Electrical Manufacturers Association**—Annual Meeting, Traymore Hotel, Atlantic City, Nov. 10-14.

• **Southeastern Electric Exchange**—Sales Committee, Atlanta Biltmore Hotel, Atlanta, Ga., Nov. 11-13.

• **Electric Council of New England**—Annual Conference, Hotel Somerset, Boston, Mass., Nov. 13-14.

• **National Association of Railroad and Utilities Commissioners**—Annual Convention, Westward Ho Hotel, Phoenix, Ariz., Nov. 17-20.

• **American Standards Association**—Roosevelt Hotel, New York City, Nov. 18-20.

• **Pacific Coast Electrical Association**—Administrative Services Conference, Hotel Claremont, Berkeley, Calif., Nov. 19-20.

• **American Society of Mechanical Engineers**—Annual Meeting, Statler & Sheraton McAlpin Hotels, New York City, Nov. 30- Dec. 5.

DECEMBER

• **American Society of Refrigerating Engineers**—45th Semi-annual Meeting, Roosevelt Hotel, New Orleans, La., Dec. 1-3.

• **Edison Electric Institute**—Industrial Relations Committee, EEI Headquarters, New York City, Dec. 4.

• Additions this week.

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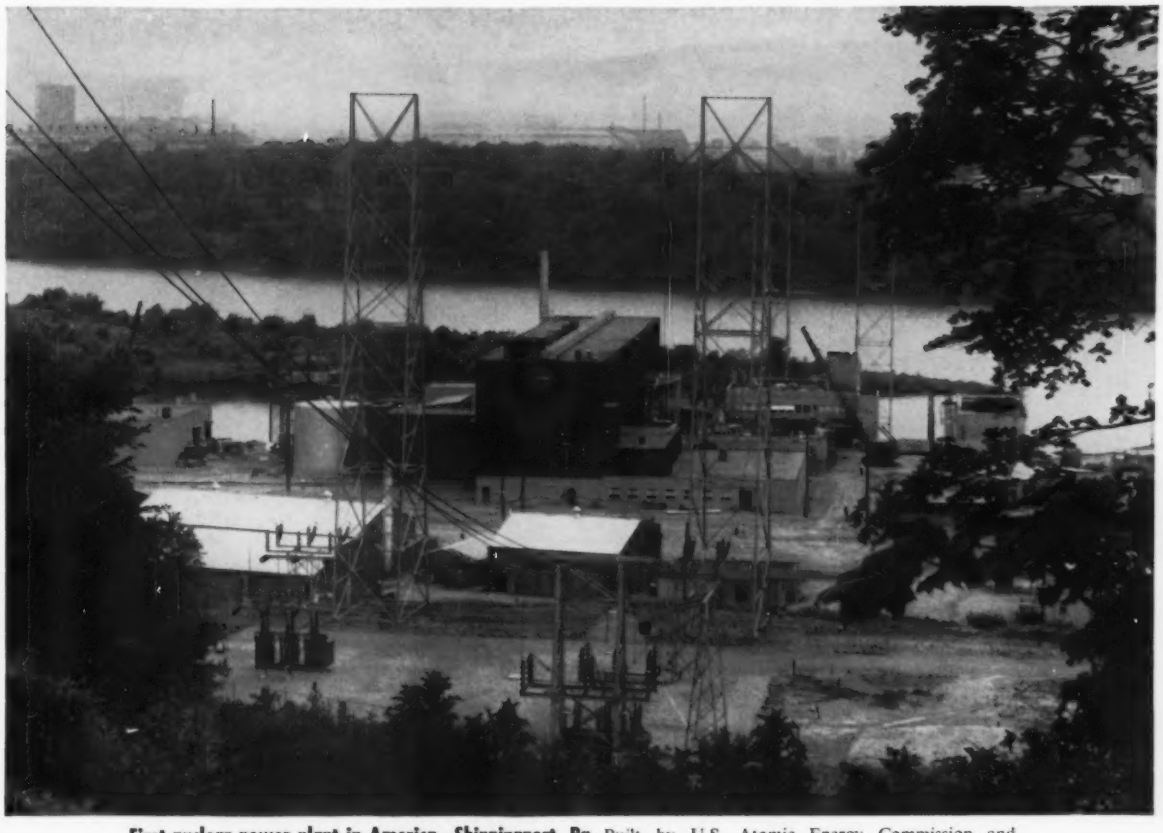

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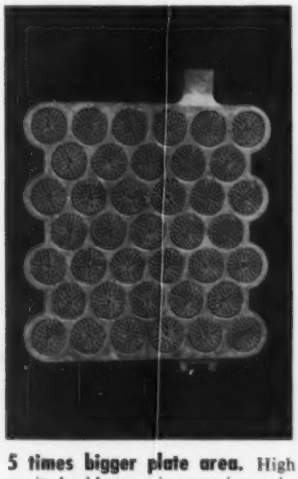
America's first nuclear power plant equipped with Exide-Manchex

Large sediment space. Cycling service life insurance. Even if reserve lead were completely used, sediment would not short plates.



5 times bigger plate area. High purity lead buttons in corrosion-resistant Silvium positive plate grid have total area 5 times bigger than plate size.

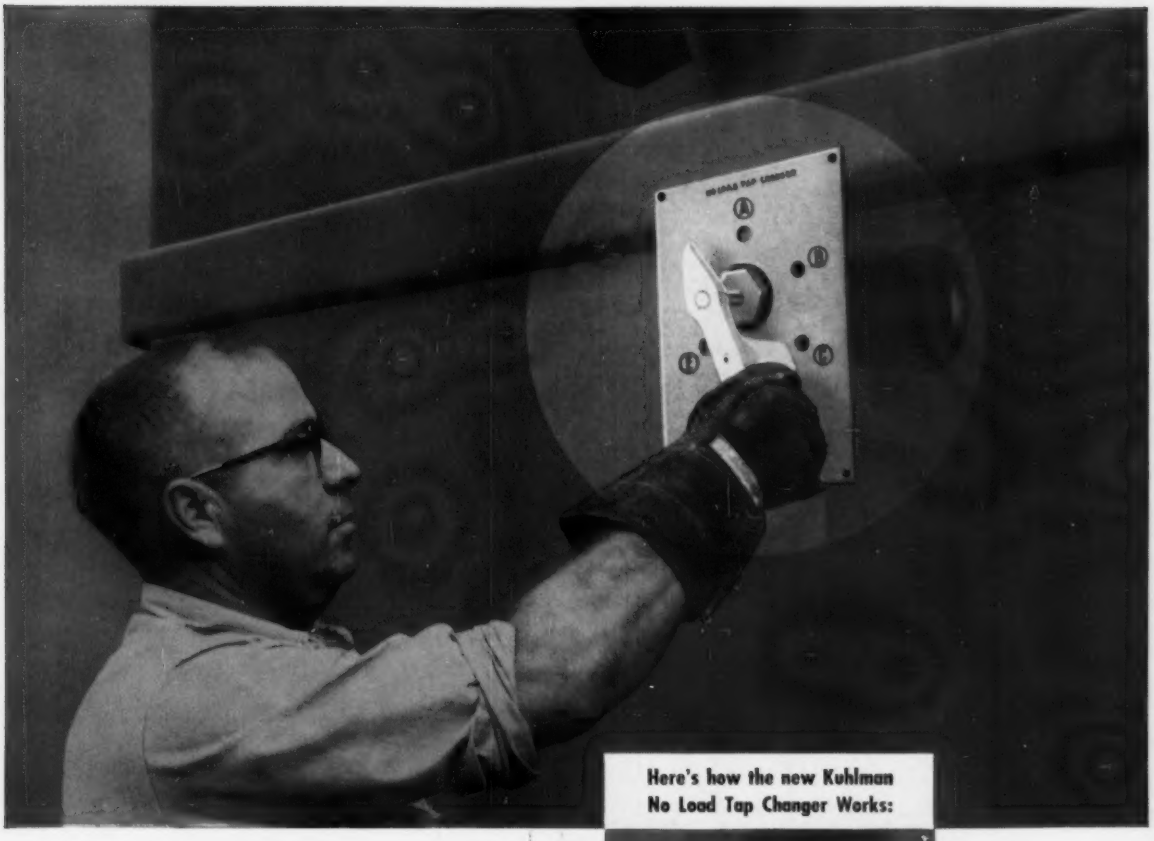
Safety is the first rule at America's first nuclear power plant, Shippingport, Pa. So battery power is used to operate the reactor rods... for essential instrumentation; for control of coolant flow; for annunciator power; for emergency lighting. The battery: Exide-Manchex.

Since it was first developed, the Exide-Manchex has continued to establish new records for life and performance unmatched by any other battery. Today, the Exide-Manchex is even better. Now Silvium grids in the positive plates mean even longer life potential. (Silvium is Exide's patented grid alloy proved up to 100% more corrosion resistant than others in common use.) Extra electrolyte above and around plates means cells need water only once a year in normal service. Large sediment reservoir qualifies the battery for cycling applications too. These are extra features not found in other stationary batteries.

For the new, detailed bulletin on the Exide-Manchex Battery, contact your local Exide representative. Or write Exide Industrial Division, The Electric Storage Battery Company, Philadelphia 2, Pa.

THE ELECTRIC STORAGE BATTERY COMPANY

Exide®



NEW!

NO LOAD TAP CHANGER* WITH *"FREE-ACTING"* ROTOR FOR AUTOMATIC, TRUE ALIGNMENT

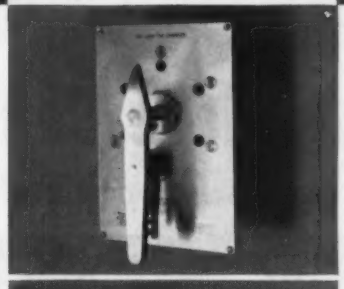
The new "self-aligning" tap changer now standard on all Kuhlman Substation Transformers puts an end to inefficient tap connections caused by misalignment.

The rotor contacts of the new tap changer function as a "free-acting" crosspin universal joint which eliminates the problem of misalignment between the rotor and stationary contacts. This "free-action" assures positive contact, true alignment always, and obsoletes the commonly used "flat surface" contacts which, by their construction, are subject to the faults of misalignment.

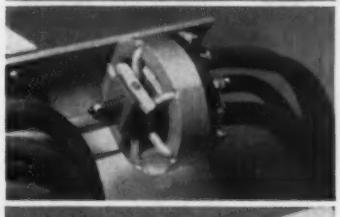
The new tap changer also features a new pistol-grip handle which locks in position and a quick-disconnect mechanism for simple, manual disengagement of the tap changer without the use of tools when untanking the core and coil assembly.

*patent applied for

Here's how the new Kuhlman No Load Tap Changer Works:



The pistol-grip trigger release allows the handle to be moved to the desired tap position. The trigger plunger then snaps solidly into position where it can be padlocked if desired.



The "free-acting" rotor contacts, functioning as a crosspin universal joint, eliminate the problem of misalignment between the rotor and stationary contacts.

Tap changer can be disconnected for removing the core and coil assembly by a tongue and groove mechanism located inside the tank.

Get all the advanced features offered with Kuhlman Substation Transformers. Write today for our new bulletin CS-701.

KUHLMAN POWER TRANSFORMERS

KUHLMAN ELECTRIC COMPANY General Offices: Birmingham, Michigan

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